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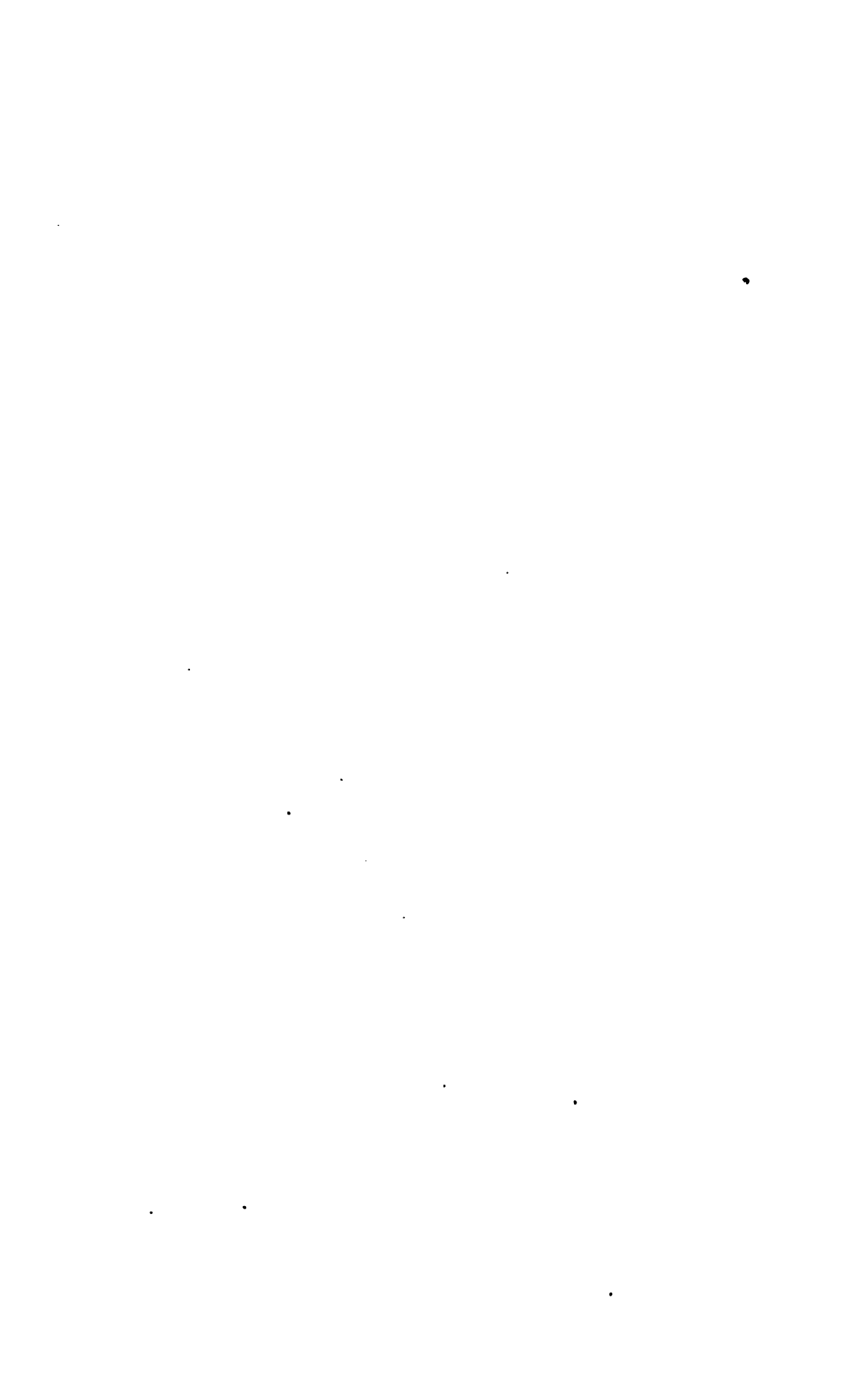
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HOSPITALS:

THEIR

HISTORY, ORGANIZATION, AND CONSTRUCTION.

BOYLSTON PRIZE-ESSAY OF HARVARD UNIVERSITY FOR 1876.

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W. GILL WYLIE, M.D.



"AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE."

NEW YORK:
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1877.

K

BOYLSTON MEDICAL PRIZE QUESTIONS.

THE BOYLSTON MEDICAL COMMITTEE, appointed by the President and Fellows of Harvard University, consists of the following physicians:

J. B. S. JACKSON, M. D.,
D. H. STORER, M. D.,
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CALVIN ELLIS, M. D.

SAMUEL CABOT, M. D.

At the annual meeting, held June 7, 1875, it was voted that no dissertation worthy of a prize had been offered on either of the subjects proposed for 1875.

The following are the questions proposed for 1876:

1. Civil Hospital Construction (not of Lunatic Asylums); Location, Materials, Arrangement, Warming, Ventilation, Drainage, Lighting; with Designs.

The author of a dissertation on this subject, considered worthy of a prize, will be entitled to a premium of Three Hundred Dollars.

Dissertations on the above subjects must be transmitted, postpaid, to J. B. S. Jackson, M. D., Boston, *on or before the first Wednesday in April, 1876.*

Each dissertation must be accompanied by a sealed packet on which shall be written some device or sentence, and within which shall be inclosed the author's name and residence. The same device or sentence is to be written on the dissertation to which the packet is attached.

The writer of each dissertation is expected to transmit his communication to the President of the Committee, J. B. S. Jackson, M. D., in a distinct and plain handwriting, and with the pages bound in book form, within the time specified.

Any clew by which the authorship of a dissertation is made known to the committee will ~~disqualify such dissertation from competition.~~

Preference will be given to dissertations which exhibit original work.

All unsuccessful dissertations are deposited with the Secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1826, the Secretary was directed to publish annually the following votes:

1. That the Board do not consider themselves as approving the doctrines contained in any of the dissertations to which premiums may be adjudged.

2. That in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

At the annual meeting, held June 5, 1876, it was voted that a prize of three hundred dollars be awarded to Dr. W. Gill Wylie, of New York, for a dissertation on "Civil Hospital Construction."

It was also voted that a dissertation on "Hospital Construction," bearing the motto "Mille mali species, mille salutis erunt," was of such a high order of merit that the committee recommend its publication by the author.

RICHARD M. HODGES, M. D., *Secretary,*
BOSTON, MASS.

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1877

PREFACE.

As there may be persons who consider the subject of this essay, especially the chapter on "Construction," somewhat outside the field of a practising physician's work, perhaps a few words in regard to the circumstances which led to the writing of it may not be out of place.

More than five years ago, while a surgeon on the Resident House-Staff of Bellevue Hospital, a large pauper-hospital of this city, I had an excellent opportunity for seeing the bad effects of poor nursing and defective construction on the welfare of patients. At that time, with rare exceptions, the nurses were ignorant and in some cases worthless characters, who accepted the almost impossible task of attending to and nursing from twenty to thirty patients each. There were no night-nurses; the night-watchmen—three in number to a hospital of eight hundred beds—were expected to give assistance to patients requiring attention

during the night. The hospital-building, originally an old prison and almshouse erected sixty years ago, had been added to, and was now a massive stone structure, with three stories and a basement. The wards were only separated from each other by the intervening partitions inclosing the water-closets and bath-rooms, which were without ventilation, except as they opened into the wards. In some instances there were only six windows to wards of twenty beds.

The sanitary condition of the hospital was shocking, notwithstanding the fact that to the visitor the wards presented a clean and orderly appearance. I saw, while on duty in the wards, patients die from septic diseases contracted in the wards after the slightest surgical operations or injuries. From forty to sixty per cent. of all amputations of limbs proved fatal; and I saw a strong, healthy man die from pyæmia following an amputation of a great-toe.

From the twelfth official annual report of the hospital I take the following :

JANUARY 1, 1872.

Number of patients remaining in hospital.....	779
“ “ admissions during the year 1871.....	6,859
“ “ births “ “ “ 1871.....	376
<hr/>	
Total number of patients “ “ “ 1871.....	7,514
Number of deaths “ “ “ 1871.....	1,102

Which gives 1 in every 6.8, or 14.7 deaths in every 100.

In a total of 1,102 deaths we find—

30 cases are recorded as caused by pyæmia.

1 case is	"	"	"	"	"	"	"	pyæmia and delirium tremens.
1 " "	"	"	"	"	"	"	"	pneumonia.
1 " "	"	"	"	"	"	"	"	necrosis of sternum.
1 " "	"	"	"	"	"	"	"	morbus coxarius.
1 " "	"	"	"	"	"	"	"	tertiary syphilis.
1 " "	"	"	"	"	"	"	"	resection of elbow.
33 cases are	"	"	"	"	"	"	"	puerperal peritonitis.

From the above we get in 1,102 deaths 69 caused by hospital-poisons, or 1 in every 15.95, or 6.02 in every 100.

Taking the number of births as representing the number of women delivered during the year: In 376 confinements, 33 died of puerperal fever, or 1 in every 11.30; or 8.7 in every 100 of all the women confined died of puerperal fever. Since the introduction of trained nurses, the removal of the lying-in patients, the reduction of the number of beds from eight to six hundred, and the use of Lister's antiseptic dressings, the condition of the hospital has been very much improved, but the faults of the buildings remain the same.

Becoming, in the spring of 1872, a member of the standing Committee on Hospitals of the New York State Charities Aid Association, I devoted my spare time to studying the subjects of trained nursing and of hospital-construction, spending a summer abroad for the purpose.

A paper read by me before the Association, December, 1873, gave substantially the same plan for a model

ward which is described in this essay. The Association requested the publication of the paper, but I felt that the subject required more study. In February, 1876, the chapter on "History of the Origin and Development of Hospitals: their Progress during the Century of the American Republic," was read before the New York Academy of Medicine, after which, deciding to compete for the Boylston Prize, I wrote hurriedly, during March, the rest of the essay, and forwarded it to Cambridge, in accordance with the conditions, 3d of April, 1876. Since then I have withheld it from the press, in hopes of gaining time to rewrite it, but professional engagements have prevented a full revision.

I do not present this book as a complete work on hospitals. For the best statement of all the details of internal management, I refer my readers to the "Hand-book for Hospital Visitors," Document No. 13, of the State Charities Aid Association.

W. G. W.

NEW YORK, *March* 1, 1877.

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HOSPITALS.

CHAPTER I.

HISTORY OF THE ORIGIN AND DEVELOPMENT OF HOSPITALS: THEIR PROGRESS DURING THE CENTURY OF THE AMERICAN REPUBLIC.

It is the common belief that hospitals, for the treatment of the sick poor, are the offspring of Christianity; that, previous to the Christian era, no such institutions as our hospitals ever existed. The best encyclopædias, both English and American, make no reference to the fact that hospitals were known previous to the coming of Christ, and not infrequently we hear men in public addresses making the same mistake. Beyond question, hospitals for the purpose of treating the sick poor were founded in India, among the Buddhists, several hundred years before the advent of Christ.

During the reign of Asoka, who died 226 years B. c., the Buddhists cut on rocks their edicts on hospitals, one of which, dated 220 B. c., can be seen to-day. It directs that along the routes of travel hospitals shall be erected, that they be "well provided with instruments and medicines consisting of mineral and vegetable drugs, with roots and fruits," and also that

"whenever there is no provision of drugs, medicines, roots, and herbs, are to be supplied and skillful physicians are to be appointed to administer them, at the expense of the state."

In Wise's "Review of the History of Medicine" (vol. i., page 392) there is a quotation from Tounour's translation of the "Mahawauso," stating that "Buddha has appointed a physician for every ten villages on the high-road, and built asylums for the crippled, the deformed, and the destitute. His son, Upatiso, built hospitals for cripples, for pregnant women, and for the blind and diseased, and Dhatu-sen built hospitals for cripples and for the sick."

Seavoncur, in his "Voyages" (vol. ii., page 489), gives an account of the Banian hospital, which still exists at Surat, at the time of his writing, about one hundred years ago:

"This curious institution was supported by the one anna per cent. on the rupee of the merchant's clear gain, to which were added the fines of certain venal offenses, under the supervision of the chief Banians. In 1770, when trade had decayed, the revenue was upward of six hundred pounds a year, and so careful were they of the animals that bread-and-milk was provided for two which could not crop grass. The hospital consisted of twenty-five acres, surrounded with a high wall, divided into courts and defended by sheds and yards for the accommodation of the animals."

Not far distant on a rock, in Guzerat, are the edicts of Asoka, cut on it more than two thousand years ago. Buchanan, in his "Hindostan" (vol. i., page 718), tells of a large tortoise, that was seen in one of these hospitals. See also the History of Medicine, by Thomas A. Wise. London, 1867.

pitals, that had been there for seventy-five years. There are, more or less, in all Buddhist countries, hospitals for incurables, lepers, and such as are afflicted with elephantiasis.

"In the city of Bangkok there is, in addition to these, a hospital for poor lying-in women; and all the male and female physicians attached to the court are obliged to give their services gratuitously to each one of these establishments.

"According to the 'Shah Nameh,' a collection of heroic poems on the ancient histories of Persia, the fire-worshippers from the earliest times were obliged by their laws to provide suitable houses for the suffering poor of their community, and the king to furnish the best medical treatment for the inmates free of all cost. In Bombay the noble hospital connected with Grant's College is the princely gift, to the sick poor, of the well-known fire-worshiper and Parsee knight, Sir Jamsetja Jejeeboy. In 1869 his wife and children erected a very magnificent hospital for incurables near it. In the same year an ophthalmic hospital was opened by another munificent fire-worshiper, Mr. Cowlesjee Jehhaugheer."¹

It is said that the sick were treated in the temples of Æsculapius, 1134 years B. C., at Titanus, a city of Peloponnesus, but there is no evidence that these temples were used for the purpose of treating the sick poor; still they were in some respects similar to our hospitals.

Dr. John Watson, in his "Anniversary Discourse before the New York Academy of Medicine," says: "As asylums, these temples bore no inapt resemblance

¹ Information from Mrs. Leon Owens, who for many years was a resident of India.

to the hospitals and infirmaries of modern times; into which, in fact, some of them were ultimately converted. The temples of *Æsculapius*, *Cos*, and *Tricca*, according to *Strabo*, were always filled with patients, and along their walls the tablets were suspended, upon which were recorded the history and treatment of the individual cases of disease."

The *valetudinaria* of the Romans, referred to by *Seneca* and other writers, and which are defined by *Andrews*, *Ainsworth*, *Cooper*, and other authorities, as places where men lie being sick, sick men's lodgings, infirmaries, or hospitals for sick folk, a sick-room, must have been institutions somewhat similar to hospitals. As they are not described by any of the many Roman historians as public institutions, they were probably something like our private hospitals—water-cures.

There was a public building on an island of the *Tiber* at *Rome* to which slaves were removed when sick, and one at *Delos* used as an asylum for aged women, and near some of the temples houses were erected for those sick while visiting them.

In the East caravansaries or resting-places for travelers have existed from time immemorial. In all of the early pilgrimages some such resting-places were customary, and were usually found near the shrines and temples.

After the birth of *Christ*, when his words began to reach the hearts of men and lead them to acts of kindness, and when *Jerusalem* and the roads approaching it were crowded with pilgrims, special accommodations for the use of those taken sick were established in connection with these caravansaries. Afterward, when monasteries and convents were established, they were

the resting-places of pilgrims, and in these we find there were special apartments arranged for the sick. In the East, in the time of the Emperor Julian, these apartments for strangers and paupers in the monasteries were called *xendochia*. Among the Romans it was the custom to set aside apartments in their houses for guests which they called *hospitalia*—and it is from this that our word *hospital* is derived, and it was from the spirit of charity taught by Christ, stimulated by the necessities of the pilgrims, that our first hospitals originated.

As early as A. D. 300 it is said that several hospitals were established for the use of sick pilgrims near Bethlehem, under the direction of St. Jerome, in whose writings the term "hospital" first appears in connection with curative establishments.¹

Besides the necessity of providing places of shelter for sick pilgrims, another cause that influenced the founding of hospitals and other charitable institutions was, that the barons of the middle ages did not distribute corn among the poor, as was the custom with the Romans; and when Christianity was introduced into the Roman Empire many slaves were set free and became helpless paupers.

"To either St. Ephraim, who died in 381, or St. Fabiola, is due the credit of founding infirmaries, which were supported by charitable contributions for the exclusive purpose of treating the sick."

Hospitals were spoken of "in the Council of Nice, A. D. 325, as institutions well known and deserving support and encouragement."²

The famous Hospital of Cesarea was founded A. D.

¹ Dr. Toner's "Contributions to the Annals of Progress in Medicine."

² Ibid.

370. The Hôtel-Dieu, perhaps the oldest hospital in Europe now in use, was founded about A.D. 600 by St. Landry, Bishop of Paris, for all sick and destitute persons of whatever sex, age, or condition. Its motto was "*Medicus et Hospes*"—sick pilgrims and mendicants all were received.

The first hospital built in England especially for the sick was erected at Canterbury by Archbishop Lanfranc. In 1070 and in 1208 the Hospital of the Holy Ghost and St. George's Hospital were established in Berlin. After this a hospital was considered requisite for every city to afford shelter to the poor and sick.

The introduction of the leprosy during the Crusades, and later epidemics of small-pox and cholera, necessitated the separation of the sick from the well, and to accomplish this many lazarettos were built. Lamothe, in his book, "*Charitable Legislation*," says that, in 1226, there were two thousand such institutions in France alone.

In 1048 a school of medicine was established at Salerno, and the same year an order, called the "*Brethren of the Hospital*," for the care of the sick in Jerusalem, dedicated to John the Baptist, was organized, and in 1118 knightly vows were added. After this brotherhoods of Hospitalers were formed and extended through Europe. As the Crusaders increased, the brotherhoods became richer and more numerous; and it was not uncommon for wealthy persons, when dying, to bequeath their property to the hospital in which they had been relieved while away from home. The hospitals established by these brotherhoods were always near and connected with a monastery or cathedral. Of their internal arrangements but little is known. It

seems that the knights or brothers bound up the wounds, and acted as physicians. The earliest account of physicians or surgeons being connected with a hospital among the Templars was under John de Lastic, who in 1437 defined the duty of the physicians and surgeons.¹

In 1456 the Grand Hospital of Milan was opened. This remarkable building is still in use as a hospital, and contains usually more than two thousand patients. The buildings stand around square yards, the principal one being much larger than the others, and separating the hospital into two parts. The main wards on either side of this large court form a cross, in the centre of which is a cupola, with an altar beneath it, where divine service is performed daily in sight of the patients. These wards have corridors on both sides, which are not so lofty as the ceilings of the wards, and consequently there is plenty of room for windows above these passages. The ceilings are thirty or forty feet high, and the floors covered with red bricks or flags. The outside wards are nothing but spacious corridors.² The wards were first warmed by open charcoal-braziers.

This hospital, built at the time when the Church of Rome was at the height of her power, and but a short time before the Reformation, is a good example of what had been attained toward the development of hospitals, and it shows how much a part of the Church the institution of hospitals was. We undoubtedly owe much to the Church of Rome. For centuries she was the only home and protector of the Christian religion. By

¹ Beckman's "History of Inventions."

² Hospitals, Infirmarys, and Dispensatories, by F. Oppert, 1867.

the devotion of her adherents, and the completeness and vitality of her organization, she successfully resisted the devastations of the barbarians, and preserved through the darkness of the middle ages what knowledge we have of the Greek and Roman civilization. In youth all is growth and progression, and change brings strength and power; but with age change means death, and length of life depends upon the power to resist change. The Church did not prove to be an exception to this law, for since the sixteenth century she has resisted all changes in hospitals. A close study of all hospitals built subsequent to this period for two hundred years on the Continent of Europe and about one hundred years in England, in fact just as long as the Church of Rome had control of the hospitals, shows that no progress in their construction was made.

In all of these hospitals the first idea in the erection was to make the hospital a church institution, and on this account the wards were clustered about the chapel. Add to this idea of making the hospital a *church institution* that of *economy* and *convenience of administration*, and take the plan of the Grand Hospital of Milan as a model, and we have the source of our modern block plan and corridor hospitals; nor do we find that this hospital, built in 1456, was to any extent improved upon until science became an important factor in progress and civilization.

About the first of the sixteenth century another cause began to influence the establishment of hospitals, namely, the necessity of providing for the care of the large numbers of sick and wounded incident to war. From the earliest ages it seems to have been the custom to have a surgeon or physician in attendance on

an army, but, previous to the times of Ambrose Paré (1560), there is no evidence that the physician or surgeon was considered a necessity, or as being of much consequence in military affairs.

As there was no special provision for the wounded after a battle, they were distributed in the nearest towns and quartered upon the inhabitants. There are one or two references by ancient historians, showing that the wounded were sometimes placed in tents, but there is no account of such a thing as a military hospital. The soldiers were taught to dress their wounds with oil and wine, and in many cases left to take care of themselves when wounded.

The Italians were the first to produce writers on military surgery about the beginning of the thirteenth century. Early in the fourteenth century the study of surgery was introduced into the Universities of Montpellier and Paris, but we find no account of a military hospital being erected until 1575, when, at the siege of Metz, through the influence of Ambrose Paré, the first famous military surgeon, one was built.¹

Thus we see that the spirit of humanity without the aid of science did not make proper provision for sick and wounded soldiers. Three hundred years later, when science had developed into such proportions as to divide the control of the world with religion itself, we shall find the experience afforded by the large number of sick and wounded incident to wars to be by far the most important influence of all others in bringing about reforms in hospitals.

In 1670 Louis XIV. began to build the Hôtel des Invalides. Beckman, in his "History of Inventions,"

¹ "On the Establishment of Army Hospitals," by Edward A. Crane, M. D.

speaking of this hospital says, "The extravagant magnificence of which is rather a proof and monument of the profusion and pride of that sovereign than of his care for meritorious soldiers." This is one of the first instances of this personal monumental idea showing itself in the construction of hospitals.

One of the first houses established for the sick poor was that built at Rome by Fabiola, a Roman lady, the friend of St. Jerome.¹ But this and all other hospitals founded by individuals were made church institutions until the beginning of the eighteenth century, when several hospitals, such as Guy's, were founded in England by individuals, and the monumental idea began to show itself in the style of building. Since then many have been built, and in almost all the idea of making a monument has been the first and most important consideration in selecting the style of building, and has lately done much to hinder the adoption of the best plans, so far as the welfare of the patients is concerned.

Before the Reformation in the sixteenth century, hospitals, lazarettos, and all other charitable institutions, were completely in the hands of the ecclesiastics, and had become a useful part of the machinery of the Church of Rome, which then in a great measure directed all the affairs of Europe. Until this time the knowledge of medicine and pretty much all learning was confined to the priesthood. In fact, until the eighteenth century almost all hospitals were more like our poor-houses than the hospitals of to-day. At this period positive science was established, but the practical adaptation of science or inventions was only just fairly begun. Curative medicine was hardly in advance of the

¹ Beckman's "History of Inventions."

time of Hippocrates, and sanitary science was in its infancy.

Early in the seventeenth century, it is said that Gustavus Adolphus of Sweden established the first regular military sanitary service, but we have found nothing to show that sanitary science to any extent influenced the construction of hospitals, certainly not civil hospitals, before the eighteenth century. After the Reformation, during the reign of Elizabeth, the age that produced the founder of Inductive Science, efforts were made, on account of the prevalence of the plague, to bring about improvement in dwelling-houses, by limiting the number of inmates in each house, etc.; and in the seventeenth century the fearful ravages of both the cholera and jail or typhus fever excited a general interest in efforts to prevent the spread of these contagious diseases.

Toward the latter part of this century, the writings of Sydenham did much to improve the science of medicine, and early in the eighteenth century we find several authors treating of air intelligently. Among these were Hoffman and Beucrus. Arbuthnot wrote a valuable treatise on air, arguing from the laws of physics.

In 1713 Cardinal de Polignac wrote "*Le mécanique à Feu*," in which he treats of ventilation, and makes use of the laws of physics in giving plans for the construction of fireplaces, and to him is due the credit of inventing the first machine for forcing ventilation. He says: "It is not the warmth of a room, but its inequality of temperature and want of *ventilation*, that is the origin of numerous maladies; we cannot, therefore, be too cautious of living in those in which this dangerous impurity of heat and motionless air exists, nor remain too

long in rooms into which temperately warm *fresh* air is constantly flowing and diffused."¹ The cardinal's method of heating the air before it enters the room, by ducts and chambers behind the fireplaces, is most scientific and ingenious.

In 1715 Jean T. Desaguliers, a French refugee then residing in London, translated the work of Cardinal de Polignac (M. Gauger) into English. In 1723 Desaguliers was requested to improve the ventilation of the House of Commons, which before that time had been ventilated by means of four holes in the ceiling connected with hollow pyramids to take off the foul air—but often cold air would descend instead.

Desaguliers very ingeniously arranged a fire with flues to heat the air in the pyramids or shafts, and thus ventilate the room. In 1727 he designed a machine, which by means of pumps forced the fresh air in, and the foul air out, of mines. In his "*Cour de Physique*," vol. ii., page 474, he describes a ventilator which he had proposed to the Royal Philosophical Society for "changing the *air* of the rooms of sick people in a little time, either by drawing out the foul air or forcing in fresh air, or doing both successively without opening doors or windows," which he thought would be of great use in all hospitals and prisons, and also serve to convey air into a distant room.² The motion was given to the air and the current established by means of a number of fans revolving in a circular case—the exact principle of the fan-ventilator of to-day.

It was not altogether original, but was the applica-

¹ Bernan's "History and Art of Warming and Ventilating," vol. ii., p. 3, London, 1845.

² Philosophical Transactions, and Bernan's "History of Ventilation."

tion and improvement of the plan proposed by Cardinal de Polignac, and was something like Popin's Hessian bellows. This centrifugal wheel-ventilator was applied to the House of Commons in 1736, and used for seventy-five years. In 1741 Samuel Sutton published a plan for drawing off the foul air of ships by means of pipes passing through the fires and connecting with the flues, thus by suction forcing out the foul air. And about the same year (1741) Stephen Hales published the description of a ventilator that worked on the principle of the bellows.

During the first half of the eighteenth century, in Great Britain there is but little to be found in medical works having a direct bearing upon hospital reform, but there were several important hospitals built; among these was the Royal Infirmary of Edinburgh.

The medical school in connection with the university, led by Alexander Munro, had grown in importance, and, as there was no hospital then in Edinburgh, the professors and those interested in the school succeeded in establishing the Royal Infirmary in 1734. The doctors took a deep interest in the erection of the building, as they were at that time the most famous in Britain; the plan adopted by them will give a good idea of the progress that had been made in hospital-construction, and is interesting as being one of the first hospitals erected with the design of subserving the interests of a medical school.

The original building is still standing; it consists of a central administrative portion with wings two stories high on either side, containing the wards; the whole hospital is one solid building, but the windows are large and opposite, and the number of beds in each

ward is small compared with the old church hospitals. In many respects it shows progress, but it is evident that the controlling ideas in the plan of construction were *economy* and *convenience of administration*.

Early in the eighteenth century, through the writings and teachings of Boerhaave, the Medical School of Leyden became the most famous of that period, and held the position of the first medical school of Europe for a generation. Boerhaave was a man of great erudition, and it is difficult to say to what extent his teachings are original; at any rate, many of his aphorisms will bear the light of science to-day, and show a comprehensiveness that extends to some of the latest scientific discoveries and methods of treating disease. The following two aphorisms have been selected as having a direct bearing upon the subject we have in hand: Aphorism 245: "But it is more especially serviceable, in the beginning of the cure, to make an exact closure of the wounded lips while bleeding, and making the dressings seldom, and very expeditiously, carefully defending the parts in the mean time from everything too moist, oily, or relaxing, and also from the *air itself*." Aphorism 200, on wounds in general: "The air of the patient's chamber should be always pure and free from putrid exhalations; that which is dry, and moderately warm or temperate, is best; and it should be frequently renewed or changed."

We will not give our explanation of these words, but that of one of his pupils, Gerard van Swieten, which we find in Van Swieten's "Commentaries on the Aphorisms of Boerhaave," published more than a hundred years ago. On page 181, vol. ii., after giving the above aphorisms, he says: "Where a great number of

wounded patients lie together in a hospital, the air is filled with putrid exhalations, which affect all of them, and kill many who otherwise might have been preserved; such places should therefore have the windows often opened, and the air changed or blown out, to remove the putrid exhalations. It is indeed often advised to perfume the place for that purpose; but changing of the air is much more serviceable to the diseased."

"But, above all, those patients are observed to suffer most for want of fresh air who have wounds in the head, as we are assured from observation." Can anything we have to say to-day express more clearly the danger of foul air and the necessity of pure air in treating wounds successfully? If Boerhaave did not originate these ideas, he at least by his learning and wisdom collected them, shaped them into living germs, and planted them in the minds of his pupils who were destined to become the first and prime movers in the development and practical application of sanitary science in treating the sick.

Among the pupils of Boerhaave, at Leyden, were Sir John Pringle and Gerard van Swieten; Donald Munro and Richard Brocklesby were also students at Leyden; all four are noted as being among the first men who wrote and taught the application of sanitary science in the construction and management of military hospitals.

Of books that had a wide circulation we have been able to find but a few that treat of the practical application of sanitary science in caring for the sick and wounded, before the publication of the writings of Sir John Pringle, and none that will compare with the advanced views taught by him. In 1750 he published a scientific essay on antiseptic substances (probably the

first on that subject), and in 1752 the first edition of his famous work "*Observations on the Diseases of the Army*" appeared. On page 86, in speaking of the causes of disease in armies, he says: "The last source is from hospitals, barracks, transport-ships, and, in a word, from every crowded place where the air is so pent up as not only to lose part of its vital principle by frequent respiration, but also to be corrupted by the perishable matter of the body, which, as it is the most volatile part of the humors, is also the most putrescent," etc.

And again he says: "As to the disposition of hospitals with regard to preserving the purity of air, the best rule is, to admit so few patients into each ward that a person unacquainted with danger of bad air might imagine there was room to take in double or triple the number." And, when speaking of hospitals and typhus fever, he recommends barns and other open buildings in preference to closed houses, and says that pure air is of more importance than warmth, and adds, "It may be received as a maxim that the more fresh air we let into hospitals the less danger there will be of breeding this dangerous distemper." He recommends open fires as the best method of heating, and says soldiers may be treated under sheds.

About this time, science was making rapid progress in all directions, and there seems to have been a general awakening to the necessity of sanitary reform.

In a small volume of Van Swieten's, published in 1760, he gives the following aphorism: "The lodging of a number of men in a place wanting in space should be avoided with the greatest care; but, should it at any time become necessary, the air must be renewed there as often as possible, whether the men who are lodged

together are well or sick, for it is from a want of ventilation that the most dangerous diseases arise, including even those which are contagious."¹

In 1764 Donald Munro published a work "On the Condition of Military Hospitals." In this he proposed the application in hospitals of Sutton's method of ventilating by means of pipes or ducts opening into the ceiling of the wards and connecting with the flues of the fires, and he also recommends the use of large sheds or wooden huts, which he says have been tried by Richard Brocklesby, and found to be the best buildings for treating the sick of the army and navy.

Long before the time of Brocklesby no doubt wooden huts had been used for sheltering the sick during epidemics, from necessity—the object being, to separate the diseased from the well, without any design of placing the sick under the most favorable circumstances to recover.

In the same year (1764) Richard Brocklesby published his "Economical and Medical Observations." In an essay on the most effectual means of preserving the health of seamen, by James Lind, M.D., published 1762, in London, we find the first definite proposal on the classification of patients. He says: "In all hospitals, there should be separate wards allotted for different diseases, and the foul wards in a hospital ought always to be the best aired, and, where the contagion is eminently malignant, spacious tents with fireplaces are greatly preferable to any close ward or apartment for dissipating infection, and for the recovery of the diseased."

Although the general interest in sanitary affairs, and

¹ Crano "On the Establishment of Army Hospitals."

the views and practical suggestions of the above-mentioned works, undoubtedly brought about important reform in the management and internal arrangements of the English hospitals, yet no hospital was built on a different plan or that could be considered an improvement on the plan of the Royal Infirmary, except perhaps one that was built at Stonehouse, near Plymouth, England.

We have not been able to get a full description of the plan of this hospital; we know that it was commenced in 1756 and finished in 1764, and used for sick seamen. The wards were in separate pavilions, with only twenty beds to the ward, and the windows were opposite. This was in all probability the first "pavilion" hospital; the name of the architect was Roverhead, of London. It was at the time considered a model hospital, and was visited by members of the committee appointed from the French Academy of Sciences in 1786, to report upon a plan with which to replace the Hôtel-Dieu, and from its detached buildings or pavilions they took ideas which guided them in preparing their famous report.

The improved plan of this pavilion-hospital at Stonehouse was not adopted in England, nor do we know of any hospital built in England on this plan until 1860, when the Blackburn Infirmary was built near Manchester, and this was but a reflection of the Stonehouse plan from the Lariboisière Hospital in Paris, which was finished in 1854 after the plan suggested by the French Academy committee in 1786, fifty-eight years before.

In the writings of Pringle, Brocklesby, Munro, and Lind, and in the building of the pavilion hospital at

Stonehouse, the spirit of sanitary reform which began with the Reformation seems to have reached its highest point of development in Great Britain, in so far as the construction of hospitals was concerned, and except in matters of internal arrangements no improvements were made, and interest in the subject of hospital construction seems to have lain dormant for a century.

On the Continent up to 1776, a century ago, we find nothing of interest to record as an improvement in hospitals. The progress of science up to that time practically had not reached the subject of hospitals. The civil hospitals were still in the hands of the ecclesiastics; and even in Paris, then the greatest scientific centre of the world, they were, according to the accounts of numerous authorities, in a shocking condition.

We have traced the development of hospitals in Europe up to the time of the Revolutionary War. We will now turn to America.

Prescott, in his "Conquest of Mexico," vol. i., p. 48, speaking of the Aztec civilization, says: "I must not omit to notice here an institution the introduction of which, in the Old World, is ranked among the beneficent fruits of Christianity. Hospitals were established in the principal cities, for the cure of the sick, and permanent refuge for the disabled soldiers; and surgeons were placed over them 'who were so far better than those in Europe,' says an old chronicler, 'that they did not protract the cure, in order to increase the pay.'"

Mr. Prescott gives, as his authorities for the above statements, "Torquemada, Monarch. Ind., lib. xii., cap. 6; lib. xiv., cap. 3;" "Ixtlilxochitl, Hist. Chich., MS., cap. 67." On page 309, of the same volume, he says, in speaking of Montezuma, "He showed a similar munifi-

cent spirit in his public works, constructing and embellishing the temples, bringing water into the capital by new channels, and establishing a hospital, or retreat for invalid soldiers, in the city of Colhuacan."

In answer to certain questions, General J. W. Phelps, an authority on the subject, writes, "There is abundant evidence to show that the Aztecs came from Eastern Asia, and that their civilization originated in Buddhist ideas." Like the Buddhists, their knowledge of medicine was considerable; but their religion, so unlike that of the Buddhists, could not have prompted the building of hospitals, for they are supposed to have sacrificed and eaten one in a thousand of their population every year, as a religious institution. It is possible that the idea of the hospital may have been directly derived from the Buddhists, and that it was prompted by their religion before this sank into cannibalism.

After America was settled by Europeans, it is said that a small hospital was established at Quebec as early as 1639.¹

The first account of a hospital in the territory now known as the United States is given by E. B. O'Callaghan, in his "New Netherland Register." In speaking of a hospital in use on Manhattan Island in 1658, he says: "This hospital was established, at the request of Surgeon Hendricksen Varrevanger, for the reception of sick soldiers—who had been previously billeted on private families—and for the West India Company's negroes. In 1679 this hospital consisted of 'five houses.'"²

¹ Dr. Toner's "Contributions to the Annals of Progress in Medicine."

² J. W. Beekman, "Centennial Address," New York Hospital, 1871.

Early in the eighteenth century pest-houses were established at Salem, Massachusetts, at New York, and Charleston, and in 1717 a hospital for contagious cases was built at Boston.

In 1750 Dr. Thomas Bond originated a movement to build a hospital in the city of Philadelphia. Dr. Bond, in his efforts to bring the matter before the people and to secure a charter from the provincial government, was assisted by Benjamin Franklin, at that time a printer in Philadelphia. The charter was granted on the 6th of May, 1751; temporary buildings were used till 1755, when the corner-stone of the present Pennsylvania Hospital building was laid, but the original plan was not completed until 1805. The hospital, built on the original plan, is now in use. It consists of a central administrative part, with two wings of wards two stories high, with a basement. Considering the early date at which the plan was adopted, it was a very good one, and far surpasses the old monastery and convent buildings that constitute a large part of many of the most renowned hospitals now in use abroad.

This was the first chartered hospital of this country. In 1775 four hundred and thirty-five patients were admitted into it.¹ The scientific and philosophical works of Benjamin Franklin had a marked influence in educating the people of this country in the practical application of the teachings of sanitary science, and from his connection with the Pennsylvania Hospital, and his writings on ventilation, stoves, etc., it seems that to him is due the credit of influencing the selection of so good a plan.

¹ Dr. G. B. Wood, "Centennial Address," Pennsylvania Hospital, 1851.

Mr. Beekman, in his "Centennial Address" before the Society of the New York Hospital, says:

"In 1771 the city of New York was a small town of about twenty-one thousand inhabitants, scarcely extending on the north as far as St. Paul's Church.

"The governors of King's College (now Columbia) had established a medical school on the 17th of September, 1767, and to the exertions of two of the professors, Dr. Samuel Bard and Dr. John Jones, the New York Hospital owes its origin.

"The charter was obtained in 1771. The governors empowered Dr. Jones in 1772, then intending to sail for Europe, to make collections of money and to buy medicines and apparatus abroad, and the next year decided to build the hospital on a plan proposed by Dr. Jones on his return.

"On the 6th of March, 1775, when hardly finished, the hospital was completely destroyed by fire, and was not rebuilt until 1791. In 1775 Dr. Jones published a little book under the title 'Plain Concise Practical Remarks on the Treatment of Wounds and Fractures, to which is added a Short Appendix on Camp and Military Hospitals: Principally designed for the Use of Young Military Surgeons in North America.'" This little book was very useful during the Revolution.

The first pages of this Appendix relate to all hospitals, and the whole subject of hospital reform is concisely expressed. In a foot-note an outline of his plan for the New York Hospital is given. As the advanced views expressed in these remarks on civil hospitals, illustrated by the few words on the plan, antedate by more than ten years any other publication we have been able to find, we will quote the following:

"Among the variety of public errors and abuses to be met with in human affairs, there is not one, perhaps, which more loudly calls for a speedy and effectual reformation than the misapplied benevolence of hospitals for the sick and wounded.

"We daily see persons of every rank and sex contributing to these charities with a spirit of liberality which does honor to humanity, while many of them, with the most becoming zeal, are devoting their time and sacrificing their private interest to the care of superintending the structure and management of the house; and yet an absurd, mistaken economy has hitherto not only rendered all this pious labor and expense, in a great measure, useless, but even fatal and destructive to the very end and aim of the intended purpose—that of healing the diseases of the sick and poor.

"To those who are unacquainted with the subject in question, it will doubtless appear a very extraordinary assertion that there is not at present, in the capital of the kingdom, a single hospital constructed upon proper medical principles; yet it is a fact very generally acknowledged by the most eminent men in the profession of physic and surgery in England.

"If we inquire into the cause of such glaring absurdities, we shall easily trace them to those sources of darkness and ignorance from which most of our civil and religious abuses have originated; but how they should be continued, to disgrace the improvements of more enlightened times, can only be resolved by reflecting on the pride, obstinacy, and self-interest, which are too generally annexed to ancient errors.

"If great and populous cities have been justly styled the graves of the human species, the large and crowded

hospitals generally built in them may, with equal truth and propriety, be denominated the lazarettos or pest-houses of most of the unfortunate persons who, from ill-directed motives of compassion, are carried into these charities. In the two great hospitals of St. Thomas and St. Bartholomew, in London, about six hundred patients die annually, which is about one in thirteen of those who are admitted as patients.

"In Paris it is supposed that one-third of all who die there die in hospitals. The Hôtel Dieu—a vast building situated in the middle of that great city—receives about twenty-two thousand persons annually, one-fifth of which number die every year. It is impossible for a man of any humanity to walk through the long wards of this crowded hospital, without a mixture of horror and commiseration at the sad spectacle of misery which presents itself. The beds are placed in triple rows, with four and six patients in each bed; and I have more than once, in the morning rounds, found the dead lying with the living; for, notwithstanding the great assiduity and tenderness of the nurses, some of whom are women of family and take the veil and piously devote themselves to that office, yet it is almost impossible, from the vast number of patients, to bestow timely assistance upon every individual.

"If we compare the number of patients who die in the county infirmaries of England with those of the London and Paris hospitals, the proportional difference will be greatly in favor of the former—in the Northampton Infirmary one in nineteen dies annually, and in that of Manchester, placed in a more airy situation, one in twenty-two; and, although the putrid air of great cities is more unfavorable to health in general than that

of country towns, yet the great difference in mortality will be found, upon a close and fair examination, to arise from the structure and crowded wards of the hospitals in overgrown capitals.

("It is to be hoped that the hospital lately built in this city will have fewer objections to its plan than any hospital hitherto constructed; the principal wards—which are to contain no more than eight beds—are thirty-six feet in length, twenty-four wide, and eighteen high; they are all well ventilated, not only from the opposite disposition of the windows, but proper openings in the side-walls, and the doors open into a long passage or gallery thoroughly ventilated from north to south.¹)

"For, if to the comparison between the mortality in large city hospitals and those of country towns we further add the proportional difference between the last and that of private practice, it will be found to be in favor of the latter. From all which facts it evidently appears how essentially necessary pure air is to the cure of diseases in general, and particularly those which arise from putrescent causes, either internal or external.

"It is computed that a gallon of air is consumed every minute by a man in health, and much more must be necessary to one who is sick, as the morbid effluvia which are continually exhaling from all parts of the body and lungs must contaminate a larger portion of the surrounding atmosphere, and render it less healthful to breathe in, for animals are observed to die much sooner in foul air than *in vacuo*.

"But, the preceding facts not having been sufficiently understood or attended to, a false economy has uni-

¹ Dr. Jones here refers to the New York Hospital, which was burned down in 1775.

versally prevailed in the structure of hospitals for the sick; for those that have hitherto had a principal direction, both in the architecture and management of them, have confined their views entirely to objects of conveniency, cheapness, or ornament; and, in one of the last hospitals built in London for lying-in women, there is more expense bestowed on an elegant chapel in it than would have furnished four wards.

“In short, the physician and architect have, generally, two very opposite and incompatible views—the latter laying out his plans so as to contain the greatest number of persons in the least possible space, whereas the former always aims at having the utmost room which is consistent with use and conveniency.

“The same false maxims of economy which have prevailed in the construction of hospitals in large cities are too much adopted in the military hospitals of camps and garrisons, as evidently appears from the complaints made of them by Sir John Pringle, to whose excellent observations on the diseases of the army I am principally indebted for the following remarks on the means of preventing diseases in camp or garrison.”

These pages, written one hundred and one years ago, in their comprehensiveness reach down to this very day; they show that Dr. Jones had studied the subject, and was well prepared to take advantage of his trip abroad, to see understandingly hospitals as they then existed, and to imbibe fully the spirit of hospital-reform at that time at work in England, and soon to express itself in France through the famous report of the Academy of Sciences.

Dr. Jones's account gives us a very good idea of the construction and sanitary condition of hospitals, just

previous to the Revolutionary War. All writers of that period substantiate the statements made by Dr. Jones, that the condition of the hospitals in France was very bad; but, if the death-rate in the London hospitals was only one in thirteen, their hygienic condition must have been as good as it is to-day. It is interesting and curious to compare this most excellent plan given by Dr. Jones as that of the New York Hospital, destroyed by fire more than one hundred years ago, with the *seven-story* building just erected for the New York Hospital on a space of ground only seventy feet by one hundred and seventy-five in extent, which is to accommodate one hundred and fifty patients. There are—

1. Basement containing dispensary, and nearly on a level with the street.

2. Private wards and offices.

3. Common wards.

4. Common wards.

5. Common wards.

6. One ward and the operating-theatre.

7. Kitchen and drying-room.

8. Laundry.

Under all this is a sub-cellar.

In the very beginning of the Revolutionary War great solicitude was shown for the proper care of the sick and wounded soldiers. After the battle of Breed's (or Bunker) Hill, a hospital was established at Cambridge "in several private but commodious houses," and Dr. John Warren, a brother and pupil of Dr. Joseph Warren, who fell while commanding the troops in that battle, was placed in charge, and soon after this several hospitals were established around Boston.¹

¹ Brown's "History of the Medical Army Service of the United States."

General Washington, after his first inspection of the army as commander-in-chief, on the 21st of July, addressed the following letter to the President of Congress: "I have made inquiry into the establishment of the hospital, and find it in a very unsettled condition. There is no principal director, nor any subordination among the surgeons; of consequence, disputes have arisen, and must continue until it is reduced to some system. I could wish it was immediately taken into consideration, as the lives and health of both officers and men so much depend on due regulation of this department."

Notwithstanding this kind consideration evinced for the sick and wounded by the commander-in-chief, and by the whole American people during the Revolution, there was much suffering on account of the poverty of the Government and the meagre resources of the country, preventing the possibility of building and conducting hospitals; consequently it was a necessity to make use of all kinds of houses for the purpose of treating the sick and wounded, and we find but little to record as adding to the development of hospitals. The first director-generals of the hospitals during the Revolution, as Dr. John Morgan, Dr. William Shippen, and most of the older and controlling surgeons, favored general hospitals; but there were several advocates of small regimental hospitals after the teachings of Sir John Pringle, among them Dr. Benjamin Rush and Dr. James Tilton.

Dr. Rush, in his "Medical Inquiries and Observations," speaking of the hospitals of the Revolution, says:

"Hospitals are the sinks of human life in an army. They robbed the United States of more citizens than

the sword. Humanity, economy, and philosophy, all concur in giving a preference to the convenience and wholesome air of private houses; and, should war continue to be the absurd and un-Christian mode of deciding national disputes, it is to be hoped that the progress of science will be so great as to prevent, so far, one of its greatest calamities, and to produce an abolition of hospitals for acute diseases.

"Perhaps there are no cases of sickness in which reason and religion do not forbid the seclusion of our fellow-creatures from the offices of humanity in private families, except where they labor under the calamities of madness and the venereal disease, or where they are the subjects of some of the operations of surgery."

In the beginning of the War of 1812, Dr. James Tilton, of Delaware, published a small volume of "Economic Observations on Military Hospitals and the Prevention and Cure of Diseases incident to an Army." In this he gives his experience during the Revolution, and describes the plan of hospital-huts and organization, presented by him to Congress in 1781; on page 13 he says: "It would be shocking to humanity to relate the history of our general hospitals in the years 1777 and 1779, when it swallowed up at least one-half of our army, owing to a fatal tendency in the system to throw all the sick of the army into the general hospitals; whence crowds, infection, and consequent mortality, too affecting to mention." Again he says: "My brethren of the faculty will probably think it an interesting fact that more surgeons died in the American service, in proportion to their number, than officers of the line; a strong evidence this, that infection is more dangerous, in military life, than the weapons of war." On page

47 he adds: "The cardinal point or principle to be observed in the direction of all hospitals is to avoid infection; when this can be done, the practice of hospitals differs little or nothing from private practice. But, where infection or foul air is suffered to prevail, no skill or address in practice can much avail. The cause must be removed before the patient can be relieved by medicine."

Dr. Tilton speaks favorably of tents for use as hospitals in warm weather, but adds: "In cold climates and winter seasons some better protection than tents afford may be necessary. In such cases the best hospital I have ever contrived was upon the plan of an Indian hut. The fire was built in the midst of the ward, without any chimney, and the smoke, circulating round about, passed off through an opening about four inches wide in the *ridge* of the roof, etc. This was the expedient I employed in the hard winter of 1779-'80, when the army was hutted near Morristown, and I was well satisfied with the experiment." He gives a ground-plan and elevation for the log-hut hospital.

Dr. Tilton was appointed Surgeon-General of the United States Army in 1813, when the office was created, and he succeeded in conducting the hospitals of that war very satisfactorily. Besides the works of Drs. Rush and Tilton, describing the American hospitals during the Revolution on the American side, and of Dr. Jackson describing those of the British, we find little of much note.

About the time of the Revolutionary War in America, the most important movement, certainly the one that eventually had the greatest influence in bringing about a reform in the construction of civil hospitals,

was made in France just after the great fire of 1772, when a part of the Hôtel-Dieu was burned. The condition of the hospital at that time was such that many favored its removal. The idea was, to divide its inmates among several hospitals, smaller, and situated farther from the centre of the city. The agitation of the subject resulted in a committee being appointed from the Academy of Sciences to report upon a plan. The committee was composed of the most eminent men of that period, Ténon, Bailly, Lavoisier, Laplace, and others, who, in their report of the 22d of November, 1786, to the ministry of Louis XVI., urged the removal of the hospital. At that time the inmates numbered five thousand, although the number of beds was only about two thousand, all the beds being double, and many holding four or six patients at one time.

The committee proposed to replace it by four hospitals of twelve hundred beds each. They claimed that "a sick-ward should be entirely detached from other buildings, so that its walls may be constantly exposed to sun and wind, and that draughts of fresh air may constantly renew an atmosphere which is perpetually fouling itself." They preferred that these hospitals should only have one floor of wards, but, as this required too much ground, the plan was modified. A Government edict, June, 1787, ordered the establishment of four hospitals at the four cardinal points of Paris, for twelve hundred beds each, and after the plans suggested by the committee of the Academy. The political events which followed prevented the execution of the project.

A supplementary report, dated the 12th of March, 1788, lays down more precisely the principles which

the plan of a model hospital resolved on by the committee represents.

They proposed, as before, detached pavilions arranged in parallel lines; that the buildings for the offices, kitchens, pharmacy, and other administrative purposes, should be in front; that the pavilions on one side should be for men, and those on the other side for women, with the chapel and operating-room, etc., in the rear of the plot.

They proposed that the pavilions should be three stories in height, twenty-four feet wide by one hundred and sixty-eight feet long, the ends of the buildings for thirty feet being wider, and containing the service-rooms for the wards; the wards to be one hundred and eight feet long and fourteen or fifteen high. They proposed that each ward should contain thirty-four to thirty-six beds in two rows, each ward having its own English water-closets, lavatory, kitchen for special diet, and sister's or nurse's room with every thing at hand for the care and comfort of the patients.

They proposed that each pavilion should be separated from the next by a garden about seventy-two feet wide and as long as the building, with nothing in it to intercept the air, and to serve as airing-ground for the patients of each pavilion. They proposed that the pavilions should be connected by a corridor running round the whole of the central court, past the foot of the stairs in each pavilion. This corridor was not to rise above the ground-floor, so as not to intercept the circulation of air.

A part of the committee visited England, and along with the idea of the English water-closets, baths, etc., they were impressed with the necessity of limiting the

beds in a ward to from twelve to thirty, a custom entirely at variance with that which prevailed in the Hôtel-Dieu, where double-beds at that time were multiplied in a ward to the number of two or three hundred. Said the Academy committee: "It is a mistake to suppose that a partition-wall will divide a ward of fifty beds into two wards of twenty-five beds each. Contiguous, communicating wards are in reality but one ward, and have a common atmosphere."

Husson, from whose works the above account is abridged, says that "the wards built for La Pitié, in Paris, 1792-1802, as dormitories for the orphans of soldiers, for whose use the building was taken, were the first instance of the application of the principles recommended by the Academy of Science." France was convulsed with revolutions, and the practical results of the committee's work followed but slowly this small beginning.

In 1788, by royal order, the memoirs of Ténon were published, and added a valuable work to hospital literature.

The work of John Howard, the philanthropist, from 1789 to 1793, in visiting all the prisons, lazarettos, and hospitals, of England and the Continent, by drawing public attention to the subject, caused not only reform in the sanitary condition and management of prisons, but of hospitals also. He recommends that hospitals should be placed out of town, and consist of buildings not more than two stories high, with large and opposite windows, and above all that in a hospital there should be perfect cleanliness.

Soon after Howard, appeared the philosophical essays of Count Rumford, who devoted his life and a

large fortune to the purpose of improving the condition of the poor. He endeavored to teach the laboring-classes the practical application of hygiene in their houses, and to him is due the credit of making the first efforts to systematize and direct charitable relief, so that it might not do more harm than good. Such a work as this must have influenced the internal arrangements and management of hospitals.

In 1803, soon after the state assumed control of the hospitals in France, the report of the Council General did much toward improving the management of the hospitals of Paris. Reform in classification, cleanliness, nursing, and change in the administration in general, were recommended.

During the first half of the present century many hospitals were built, and several well-known works, that had some influence on hospitals, were published; among these are the writings of Morneau, in 1802; Pastoret, in 1808; Cutbush, in 1808; Clavereau, in 1810; Larrey, in 1812; Barton, in 1814; Hennan, in 1820, etc., etc.; and there was a gradual improvement made in the internal arrangements; but, except in matters of this kind, nothing was advanced that could be considered an improvement upon the principles and plans given in the report of the committee of the French Academy of Sciences.

In fact, with one or two exceptions, in none of the many hospitals established after 1786—the date of the report—were the advanced views of the committee carried out. Almost all the hospitals built were large, solid, many-storied structures, with the wards and administrative offices, etc., all in one building. In 1829 a hospital was built at Bordeaux reproducing the plan

recommended by the committee; and it was not until 1854, sixty-eight years after the report, when the Lariboisière was finished, that Paris had a hospital to show as the fruits of it. The plan of the Lariboisière is almost exactly that proposed by the committee, and is only an improvement on it in detail, excepting, perhaps, the ventilating apparatus.

Previous to 1859 neither England nor the United States had a civil hospital that would compare favorably with the plan proposed by Dr. John Jones in 1773. One of the first pavilion-hospitals built in England, after the plan proposed by the French Academy's committee, was Blackburn Infirmary, in 1859. The first in the United States was the Episcopal Hospital of Philadelphia, founded in 1860.

In Germany there seems to have been but little progress in the development until the early part of the present century, when the plan of hospitals known as the corridor-hospital was introduced and very generally adopted. The hospitals of Russia were modeled after those of Germany, and were in no respect better.

The next progressive step, after the report of the French Academy's committee, in the development of hospitals was brought about by the fearful death-rate of the English and French armies in the beginning of the Crimean War. So great was the mortality, that the whole English people were aroused to the necessity of better provision being made for the sick and wounded. Miss Nightingale, who had the training as a nurse at Kaiserwerth, selected a band of thirty-seven nurses, and left for the seat of war on the 24th of October, 1854, and in 1855 the Government appointed a sanitary commission to proceed at once to the Crimea; the mem-

bers of this commission were John Sutherland, M. D., Hector G. Milroy, M. D., and Robert Rawlinson, Esq., C. E. They succeeded in introducing many valuable sanitary reforms.

In 1854 Michel Lévy, Sanitary Inspector of the French army in the Crimea, suggested the use of wooden barracks or huts for hospitals, and at the same time proposed a permanent tent-hospital. It was found by experience that simple wooden huts, raised from the ground, with double walls—to protect from the heat in summer and cold in winter—with ridge-ventilation, and heated by means of open fires or stoves, gave far better results than any other kind of building.¹

The following, afterward expressed by Dr. Sutherland, will give the best idea of what was taught by the experience of the Crimean War. He says: "But, while admitting that large buildings may be improved if there be time for doing so, it must be stated that no more disastrous idea can take possession of men's minds than that sick and maimed people ought, on grounds of humanity, to be packed into churches, barracks, and other unprepared buildings, with as little delay as possible. This error has slain its tens of thousands in all wars."

The indefatigable and practical work of Miss Nightingale in the hospitals during the Crimean War, and her masterly-written answers to the questions of the "Commissioners appointed to inquire into the Regulations affecting the Sanitary Condition of the Army and the Organization of Military Hospitals, and the Treatment of the Sick and Wounded," published in 1858, have justly made the name of Florence Nightingale

¹ Report of the Proceedings of the Sanitary Commission dispatched to the Seat of War in the East, 1855-'56.

most famous not only in connection with nursing, but hospital-construction also. In 1859 the first edition of her well-known book, "Notes on Hospitals," appeared.

This book of Miss Nightingale, on account of its real worth and the earnest, practical, and telling way in which it is written, has done more to bring about reform in hospital-construction than any other work ever written. And her book, "Notes on Nursing," has made her name a household word wherever the English language is spoken.

These two books of Miss Nightingale were the first to reach and educate the *people*. The general interest in hospital-reform was very great in England for years after the Crimean War, and the discussion of the subject between the advocates for new and improved hospitals to replace the venerable old hospitals, and the non-progressive and conservative party, still shows itself. The "General Commission appointed for improving the Sanitary Condition of Barracks and Hospitals" made a report, April, 1861, signed by John Sutherland, W. H. Burrell, and Douglas Galton, which accepted the experience of the Crimea, and the suggestions of Miss Nightingale, and settled the question in regard to military hospitals by the adoption of what is known as the barrack-hospital plan.

In answer to the reforms proposed by Miss Nightingale, and to counteract the general feeling that all old hospitals should be replaced with new ones, the medical officers of the Privy Council, Dr. Bristowe and Dr. Holmes, after visiting almost every hospital in the United Kingdom, made a most excellent but *very conservative* report.¹

¹ Sixth Report of Medical Officers of the Privy Council, Eyre & Spottiswoode, London, 1863.

Sir James Y. Simpson took up the subject and brought forward statistics to show the relative mortality of private practice and small hospitals in the country, compared with the mortality of large city hospitals, and, in his paper on "Hospitalism," advocates small cottage-hospitals, outside the city limits. He was answered by Matthews Duncan on the conservative side.

Lately the subject of hospitalism was warmly discussed in the British Medical Association, and in 1874 Mr. Erichsen published, in book-form, a course of lectures on "Hospitalism." This little book, in which the need of hospital-reform is plainly shown, not alone in the matter of construction, but especially in all that concerns internal arrangement, is of very great value.

The practical results of the interest in hospitals brought about by the Crimean War were, the building of the famous Herbert Hospital at Woolwich, and the establishing on a sure basis the detached pavilion-plan of hospital-construction, the plan which had been proposed, and on which a small hospital (Plymouth Naval Hospital) had been erected, just one hundred years before. The Herbert Hospital is an improvement upon the Lariboisière; but, like it, is modeled after the plan proposed by the French Academy's committee of 1786—the improvement being mainly in the details of internal arrangement.

Until the building of the Herbert Hospital, the Lariboisière was the model hospital of the world. Now, in the United Kingdom, the Herbert Hospital is the model.

Since the building of the Herbert Hospital, several hospitals have been erected; among these the new St.

Thomas's, which only surpasses the Herbert in magnificence of construction, but, instead of two floors of wards to the pavilion, has three with an attic, and all the pavilions on one side of the corridor.

The Rotherham Hospital, lately finished (1872), has three small one-story wards. It is the only civil hospital completed on the one-story plan, that we know of, in England. One for one hundred and fifty beds is building at Manchester.

The influence of the Crimean experience did not do so much for France. M. Husson's well-known work was published in 1862, but nothing better than the Lariboisière was proposed. In Germany the corridor-hospital had not been improved upon, nor until within the last ten years had any important progress been made.

Before the interest in sanitary and hospital reform caused by the Crimean War had quieted down, the American people had an opportunity afforded them to make use of the valuable suggestions published in the reports of the English commission, and, in doing so, succeeded in developing the most perfect system of army-hospitals ever known to the world.

Early in the late civil war a sanitary commission was organized, of which the Rev. H. W. Bellows, D. D., was chairman. In July, 1861, the committee on hospitals of this commission reported: "Your committee venture to embody their conclusions in form of suggestions, and would submit to the commission the propriety of recommending to the Government that hereafter, instead of hiring old buildings for general hospitals, they should order the erection of a sufficient number of wooden shanties or pavilions of appropriate

construction, and fully provided with water for bathing, washing, and water-closets, and ample arrangements for ventilation and for securing warmth in winter, to accommodate from thirty to sixty each, and to be sufficiently separated so as not to poison each other. This suggestion embodies the latest and best views as to the construction of hospitals, and its adoption would save both time and money." And at the close of the October session of the commission it was understood that the Government would at once commence the erection of two cheap temporary model hospitals at Washington, "in conformity with plans carefully prepared by a committee of the medical members of the commission, and approved by it, as embodying the latest results of sanitary science. The plans have been formally approved by the quartermaster-general, the commander-in-chief, and the medical director of the Army of the Potomac, and the ground for the example-building has been staked out."¹

The medical members of the commission were William H. Van Buren, M. D.; Wolcott Gibbs, M. D.; Robert C. Wood, M. D.; Samuel G. Howe, M. D.; Elisha Harris, M. D.; C. R. Agnew, M. D.; J. S. Newberry, M. D. Mr. F. L. Olmsted, civil engineer, was also a member of the commission.

The works of Miss Nightingale and the Crimean experience are frequently quoted by the committee, and the plan of army-hospitals adopted was the practical application of the temporary one-story Crimean hut with ridge-ventilation, extended to the size of the wards recommended by Miss Nightingale. The wards were

¹ United States Sanitary Commission Work and Purposes, New York, 1864.

connected by a corridor, and the first ones erected had the pavilions arranged on opposite sides of the corridor after the plan of the Blackburn Infirmary.

The water-closets, nurses' rooms, etc., were usually placed at one end of the ward, or divided between the two, the water-closets being at the free extremity, and the nurse's room and dining-room next to the corridor. The number of beds in each ward varied from twenty-five to fifty. The wards were temporary in character, with ridge-ventilation, and usually heated by stoves. The administrative buildings were separate from the pavilions and connected with them by the corridors; the wards were always one-story buildings. In fact, the plan really differed from that recommended by Miss Nightingale in these respects: the pavilions were only one story high, were temporary in character, and always had ridge-ventilation.

The first hospitals were for only two hundred and fifty beds, but later they were much larger; one, the "West Philadelphia Hospital," contained 3,124 beds in wards of forty-eight beds each.

The system was thoroughly tested during the war on a scale never before equaled, there being at one time in the Government hospitals as many as 134,000 beds. The success was such that an army averaging 744,346 men passed through a four years' war with an annual death-rate of only eighty-eight per thousand from all causes, and it is estimated that thirty-three out of the eighty-eight were violent deaths, leaving fifty-five from disease in one thousand.

The same system and plan of hospitals were adopted by the Confederate army during the war.

The experience of the war may be said to have de-

veloped and established the following principles in the construction of hospitals:

1. That the hospital should be placed on a large area of ground, so that the pavilions can be widely separated from the administrative buildings and from one another.

2. That the wards should be *only one story* in height, and be ventilated by openings along the ridge of the roof.

3. That the ward-pavilions should be put up not to remain for generations to come, but only so long as they are free from infection; and that, when once they are infected, they should be destroyed, and replaced with entirely new structures.

Soon after the war, one-story wood pavilions of a temporary character for the treatment of contagious fevers were put up on Blackwell's Island, New York, and in different places in the United States. Small ones also were built in connection with large hospitals for infectious cases; but the first complete civil hospital, constructed after plans used during our American war, is to be found in Germany. In 1867-'68 a one-story ward-pavilion hospital was planned and soon after built in Leipsic. The old stone hospital is used as an administrative building. There are fourteen one-story ward-pavilions, or shed-hospitals as the Germans call them. They are frame buildings filled in with brick, one hundred feet long, thirty-two feet wide, fifteen feet high at the eaves and twenty at the ridge. They are placed sixty feet apart, raised four feet from the ground on stone piers, and are connected by a corridor. They have ridge-ventilation.

Each ward or shed has twenty-four beds, with

nurse's room, baths, kitchen, and closets, complete. During twelve months, Prof. Thiersch, who has charge of the surgical clinic, performed two hundred and sixty-six serious surgical operations, and did not lose a case from pyæmia; while, prior to the construction of the new pavilions, in the old stone hospital, which is now the central building, he lost from forty to fifty amputations from this cause annually.

In 1867, at Berlin, a one-story ward was built in connection with Charity Hospital by Dr. Esse. Kiel has two stone one-story ward-pavilions used as a garrison hospital, and at Dresden one-story ward-pavilions have been built.

Dr. Stephen Smith, of New York, wrote an essay upon hospital-construction, and recommended a plan for the Roosevelt Hospital. The plan recommended by Dr. Smith in this essay is very much the same as that of Miss Nightingale. The Roosevelt Hospital, opened in 1871, has one one-story pavilion to show, as the influence of the experiences of the war, but New York City has had six other large new hospitals, all of which are massive, many-storied buildings, costing immense sums of money; and one of these, the last, is seven stories, and on a space of ground seventy by one hundred and seventy-five feet.

In Boston, Massachusetts, the one-story pavilion plan with ridge-ventilation has been adopted, and there are two or three pavilions erected on the grounds of the Massachusetts General, and one on the ground of the Boston City Hospital, which surpass any in this country, except perhaps one lately constructed in Philadelphia.

The organization of our Sanitary Commission and

the plans for military hospitals were carefully studied and efficiently used by the Germans in the late Franco-German War.

So great was the success in treating the wounded in the hospitals constructed on the American plan, that since the war the Germans, in their thorough and exhaustive way, have taken up the subject with the view of applying these principles to their civil hospitals. Some of the first men in medicine and science have written monographs on the subject, such as Virchow, Steinberg, Esse, Esmarch, etc., and some of the professors of hygiene and surgery take up hospital-construction as a part of their course in lecturing to students.

Within the past ten years several books and many monographs and papers have been published on the subject of hospitals, which we have not mentioned. Among the books are: "On the Construction of Hospitals," by Douglas Galton, 1869; "Handy Book on Cottage-Hospitals," by Horace Swete, 1870; "Notes on Lying-in Institutions," by Florence Nightingale, 1871; and "Hospital Construction and Organization," JOHNS HOPKINS HOSPITAL, 1875. Through the munificence of the late Johns Hopkins, the trustees of the Johns Hopkins Hospital, of Baltimore, have at their command three million dollars (\$3,000,000), and fourteen (14) acres of land to establish a General Hospital of three hundred (300) beds. We trust they will build a model hospital embodying all the late improvements, which will be worthy of the Centennial Year of our Republic.

CONCLUSION AS TO THE ORIGIN OF HOSPITALS.

THE chief object aimed at in a hospital is to preserve life and relieve suffering. Every living thing has a certain amount of power to repair itself when injured, and everything that has life has the power given it to resist to some extent that which tends to destroy it. A tree will grow more wood on that side sustaining the greatest strain of a prevailing wind, and will grow to a great height before spreading, if the shrubs and trees around make this necessary, to enable it to get its share of sunlight. The higher the organization, the greater is this power of self-protection. When we reach living things which have a nervous system, this power of self-protection becomes more marked and is called the instinct of self-preservation. As we ascend the scale of animal life this instinct gradually widens its circle of influence, and includes not only self but those of their kind. Before we reach man, we see undoubted instances of mutual sympathy and even love evinced by the individual members of more than one race of animals for others not only of the same species, but of entirely different families.

The idea of curing disease seems to be plainly foreshadowed in the instincts of animals. The sick dog will seek and chew his medicine-grass, which, when well, he never touches; the cattle of the pine-wood districts, where phosphorus is wanting in the grass, will deliberately hunt up and chew bones which under other circumstances they would not eat.

In the crude development of religion and of the curative art these will invariably be found associated in the same individual. The medicine-man is the priest,

and the wise man who cures the evil spirit is the doctor. Society follows the general law of development of organisms, viz., the growth of special organs for special functions, which become more distinct one from the other, yet at the same time more dependent one upon the other. We therefore find, in higher civilizations, doctors of disease distinct from priests; and, in the highest and most complete civilization of all, the priest making use of the doctor of medicine to help him do his work of charity. The hospital is the outcome.

It is true that hospitals nowadays are often organized and carried on independently of religious considerations, purely on utilitarian grounds, to protect the well from infectious and contagious disease; but this presupposes a knowledge of disease that did not exist at the date of the origin of the first hospitals. Charity and brotherly love influenced men and took shape in religious organizations long before sanitary science existed, or made itself felt through the art of medicine.

History shows us that the credit of the origin of the first hospitals is not due to medicine, but to religion.

So far as our knowledge of history goes, and as we have shown in the foregoing *résumé*, we find that hospitals, as we understand them, have been the outcome of only two or three civilizations, namely, that of Buddhism, the fire-worshippers, and the Christian civilization. In what way can this be accounted for? It cannot be due to the degree of civilization, for both Greece and Rome, in many ways, reached a higher state of civilization than did the early followers of Buddha or Christ; and yet, hospitals for the sick poor did not exist to any extent, if at all, among them. It may be said that their laws were so perfect and efficiently carried out, that

hospitals such as we have were not needed; but hospitals must have been needed after battles, when the soldiers were far removed from their homes. A more plausible excuse would be to say that the science of medicine had not advanced to the same extent as among the Buddhists and early Christians.

We cannot speak so confidently about medicine among the Buddhists; but we know that, at the time of the founding of the first hospitals by Christians, medicine was not in advance of the time of Hippocrates. If the Buddhists did excel in medicine, judging by the experience of to-day, it is more than probable that much of this knowledge was acquired from the advantages afforded by their hospitals for the study and practice of medicine. There was nothing in the religion of either the Greeks or Romans that made life sacred, or that taught brotherly love. Physically and intellectually they reached a high state of development, but they made morally but little progress. The Buddhist, taught to believe that every living creature is sacred, does all he can to prolong life; and to this end he builds hospitals, not only for men, but for animals and even insects. The Christian, following in the footsteps of his Master, extends his love and sympathy to all mankind, and, in his efforts to show his sympathy by his acts, he builds hospitals to prolong life and to relieve his suffering fellow-beings.

CHAPTER II.

RELATIONS OF HOSPITALS TO PAUPERISM.

HOSPITALS may be classed as follows :

1. Public eleemosynary hospitals founded, supported, and managed, by the state or municipal authority.

2. Public eleemosynary hospitals founded usually by an individual, then incorporated under a charter, given to a number of citizens as an association, supported by endowment and by voluntary contributions, and managed by an honorary board selected from the members of the society.

3. Army and navy hospitals established, supported, and managed, by the state or government.

4. Church eleemosynary hospitals founded, supported, and managed, by a number of persons representing a sect or church.

5. Private hospitals carried on in the interests of individuals.

Civil hospitals may be divided according to the classes of diseases treated in them :

1. General hospitals for the treatment of medical and surgical diseases that are not contagious or infectious. As a rule, general hospitals have one or more departments for the treatment of special cases connected with them.

2. Special hospitals—

- For children ;
- For lying-in women ;
- For fevers, as small-pox, typhus, etc. ;
- For diseases of women ;
- For eye and ear ;
- For throat ;
- For epileptics ;
- For incurables ;
- For crippled ;
- For convalescents ;
- For insane, etc., etc.

* Civilization has not reached that state of perfection in which hospitals can be dispensed with.

As long as armies exist, hospitals will be necessary. Soldiers removed from their homes, when sick, must be provided with special accommodations ; and after a battle the vast number of wounded cannot be properly cared for except in hospitals constructed especially for the purpose.

During epidemics of contagious and infectious diseases it becomes a necessity to separate those infected from the well, and for their accommodation hospitals must be erected.

In every community, especially in large cities, there is always a certain number of paupers without any *homes*, who must be cared for when sick, and the only practical way of providing for them is to establish hospitals.

In large cities provision must be made for street-casualties, and hospital-accommodations are necessary.

Lastly, on account of difficulty in making suitable

provision for the insane in private houses, hospitals or asylums for the insane are necessary.

Throughout the Christian civilized nations of the world the necessity for the establishment of hospitals, on account of the above reasons, is recognized. Every military post, where considerable numbers of soldiers are stationed, has its hospital; and no army outfit is complete without special arrangements for the erection of suitable hospitals for the reception of the wounded. Every city either has ready or speedily erects hospitals to receive the infected during contagious epidemics, and all cities and large towns have hospitals for the accommodation of the sick poor. In every country many insane-asylums, both public and private, are found.

Army hospitals are necessary, and hospitals for the insane and for contagious and infectious cases are necessary; and their size and number must be regulated as the circumstances demand. But, in regulating the hospital accommodations for the sick poor, necessity does not so definitely fix a limit, and many perplexing questions arise.

In this country, in all large cities, any one representing himself as poor and sick can apply either to the public hospitals supported by the State or to hospitals supported by voluntary contributions; and, if, on a simple *medical* examination, his disease is of the class treated in the particular hospital—and there are hospitals for every disease—he is admitted without reference as to whether he has a home, and in many cases without any special inquiry or investigation as to his circumstances.

In some places, as New York City, hospitals are so numerous, and admission to them so freely granted,

that there is little or no restraint on impostors. If refused admission to one institution, they go to another, and receive treatment and care without cost, when they are fully able to provide for themselves. And so numerous are the dispensaries where medicines and medical advice can be obtained free of cost, merely for the asking, and so easily and readily can care and attention be had in free hospitals, that the poor have no necessity to make provision for sickness, nor any inducement to guard against disease, and so avoid the trouble and expense incident to sickness.

It is estimated that about \$10,000,000 are expended in public and private charities annually in the city of New York, a city of one million inhabitants. A considerable portion of this sum is expended on the hospitals, which alone contain more than 6,000 beds, not including insane or other asylums, but only institutions known by the name of hospitals. About 4,000 of the 6,000 beds are in public city or State hospitals, the remaining 2,000 being in hospitals supported by voluntary charity. The official reports of the thirty-odd free dispensaries give 307,060 as the number of patients applying and receiving treatment in 1875 at the dispensaries, against 20,631 treated at their homes by these institutions.

To say that \$10,000,000 are expended in charities, that there are 6,000 free beds in the hospitals, and that over 300,000 persons receive medicine and medical advice free of cost at the dispensaries, is certainly evidence of the generosity and Christian spirit of charity that prevail. But, when looked at in a direct, practical way, these figures show something else. If these official reports are *to be relied upon*, then, in a population of

one million, over 300,000 persons receive alms every year; or about one in every three of the people is willing to, and does, take alms! We have added together the numbers reported in the "Hand-book of the Benevolent Institutions and Charities of New York in 1876," as being the number of patients *treated* by the dispensaries in 1875, and the sum total is, as stated above, over 300,000. We doubt if the number of individuals is so large, for it is the custom of some dispensaries to count each visit a patient makes as a patient treated; but the actual number is immense, and increasing out of all proportion to the increase of population.

The truth is, the majority of our hospitals, *as they are at present managed*, are liable to do more harm than good. Apparently they do much good, and for the time do relieve suffering and want, but in the end they may do much harm. Giving help too readily, even during sickness, is hurtful; and when it is offered freely, without the certain knowledge that it is really needed, it very naturally removes the healthful stimulus of necessity, the dread of which prompts every individual to guard against and provide for the misfortune of sickness.

The dispensaries, as they are now managed, without any certain knowledge as to the need of the help they give, are nothing less than a promiscuous charity exactly similar to the notorious "soup-kitchens," medicine being substituted for soup. They offer to the ignorant and poor an easy and ever-ready inducement to take alms. They are the first stepping-stones to the degradation of pauperism. The self-respect of an individual is injured the moment he accepts alms, and a habit of taking alms invariably tends to a complete loss of self-

respect and consequent degradation. It matters but little whether alms be medicine or food, the principle remains the same.

The hungry must be fed; but we know that, instead of continuing to feed the hungry, and gradually destroying their power to help themselves, it is infinitely better to teach them self-help, and to seek out and remove the cause that induced the miserable condition of helplessness. For exactly the same reason, would it not be better to teach the poor how to avoid getting sick, and by every means in our power remove the causes that induce disease among them, rather than to offer them the best care and attention, without being sure that they need help, thus teaching them to become careless about avoiding sickness?

It would be more creditable to the citizens of New York, if they could say that no such institution as a pauper hospital was needed within the limits of the city, than it is to be able to say that two hundred established charitable institutions and organizations are maintained; and instead of so many millions being spent in caring for the sick, would it not be better if the same money, or perhaps only a small part of it, were spent in carrying out sanitary works, and teaching the people the laws of health?

Suppose that, during the prevalence of an epidemic of a contagious disease, the authorities should content themselves with providing for those infected, and neglect to take the necessary steps to remove the cause of the disease by doing all that sanitary science indicated: they would soon be called to account for neglect of duty. It is a well-known fact in science that the great majority of the cases of disease treated in our hospitals

are induced by the bad sanitary condition of the homes of the poor, and by the direct violation, through ignorance, of the plainest hygienic laws; yet what direct steps are taken to correct this constantly-acting cause of sickness? The Health Department of New York City is expected to do little else than prevent epidemics of contagious and infectious diseases. The meagre appropriation prevents them from doing much more.

This statement concerning the hospitals and charities of New York City cannot be called a fair example of the condition in smaller places, but it shows very plainly and truthfully the prevailing faults in the administration of charities throughout the country. If the results in smaller places are not so bad, it is due to local circumstances, and not to a better understanding of the subject, nor to the adoption of a more enlightened system.

The circumstances are very much in favor of the smaller cities and towns. Leaving out the many well-known causes that tend to generate pauperism, and thus increase the relative number of paupers in a large city, which do not exist in towns or small cities, the main reason that charity does not do so much harm in the latter is, that the circumstances and the character of every one are well known to the people, and this personal knowledge guides and directs the givers of charity; whereas, in the large cities, it is seldom that the giver of charity knows to whom he is giving, and *personal knowledge* rarely exists at all; when it does, it is usually of such a character as to be of but little practical value. The difference between the life of the rich and of the poor is so great that the rich cannot comprehend the real needs of the poor. Charity with-

out this relation is like a man with a heart, muscles, and a spinal cord, to respond to external influences, but without a head and the brains to coördinate and direct his acts. Unless these personal relations exist between those who give and those who receive, no act of generosity deserves the name of that charity which "blesseth twice," for gratitude is not developed in those receiving help; they give nothing in return for what they receive. Experience teaches that to do for an individual that which it is possible for him to do for himself will invariably tend to harm, unless he gives in return an equivalent either by actual payment or in gratitude. And experience also teaches that human nature can only feel gratitude toward an individual. In religion, God is represented as an individual, and for all his great blessings we are told to "love him with all our heart, with all our mind, and with all our soul." We are not what we should be unless we give an equivalent for all we receive. When the king was the state, he could give to the poor, and receive love and loyalty in return; but now the people, the voters, the paupers themselves, are a large part of the state, and paupers take their alms from the state as a *right*.

Besides this tendency in hospitals, as charitable institutions, to increase pauperism, another serious objection to the use of public hospitals for the purpose of treating the sick beyond the extent absolutely demanded by necessity is, that every time an individual is removed from his home—let that home be never so humble—and taken to a hospital, the family as an institution receives a blow. Then, too, except to those already degraded, life in a pauper hospital, especially with the young, is hardening to the feelings, while in many

cases it subjects the moral to the influence of the immoral.

Another objection to hospitals is the bad sanitary condition of many of them, and unless this is improved, both as to the plan and the construction of the buildings, and the general and internal management, so as to give a smaller death-rate, and fewer deaths from hospital-diseases, than in the vast majority of hospitals now in use, it will be decidedly better, *on sanitary grounds alone*, to treat in their homes all the sick poor who have homes, even though they may be very bad and unhealthy places to live in. As to the expense of treating the poor at their homes, it certainly would not be greater than the expense of running the hospitals, if the interest-money is added which could be had from the immense sums that are sunk in the massive, many-storied hospital-buildings and the expensive city lots on which they stand.

But, as poor-relief is now administered (and no doubt under the best system that could be devised), a certain number of hospitals for treating the sick poor will be necessary. When properly constructed and managed, they are a great blessing to the poor; while, from the many advantages they afford for the study and teaching of clinical medicine and nursing, they are of incalculable value to the whole community. Without hospitals the difficulties in teaching practical medicine would be very great, and the whole method of giving clinical instruction would be changed. A medical school without the advantages afforded by hospital instruction is a failure, and no one can expect to attain eminence as a teacher or as an author in medicine or surgery without hospital experience as a basis, and hos-

pital practice and statistics as illustrating and verifying his views.

Since the establishment of the training-school for nurses in connection with St. Thomas's Hospital by Miss Nightingale, in England, sixteen years ago, and in this country of the school for nurses in connection with Bellevue Hospital, New York, four years ago, the great advantages of hospital instruction are recognized for those who are studying nursing.

There is a popular belief that doctors experiment on hospital-patients, but only those ignorant of the facts as they are at the present time can have such an idea. In this country, at least, the acts of a physician in a hospital are more public and open to criticism than in private practice. What he does is done in the presence of several and often many persons capable of understanding whether he is making an experiment, and if he makes a mistake it is known to all the hospital-staff; whereas, in private practice, if he has the confidence of the immediate family, on account of their inability to understand, he can venture and make mistakes without discovery.

In the founding of hospitals the question of their usefulness to medical education has not been given due consideration. As a rule, the idea of rendering immediate personal relief to the suffering poor is the first, and in many cases the only, acknowledged object aimed at in establishing them.

The objections to civil hospitals, as now stated, may be said to be—

1. As institutions, they tend to weaken the family tie by separating the sick from their homes and their relatives, who are often too ready to relieve themselves

of the burden of the sick and helpless of their family. Besides, when one or more of a family are removed, those left at home are in an uncertain state of mind, and in many instances in an unprotected condition. The husband loses the good influence of his wife, and the wife the protection of her husband.

2. The inmates of pauper-hospitals are liable to come in contact with bad influences; familiarity with suffering, unaccompanied by the occupation of relieving those who are suffering, ends in hardening the sensibilities, especially in the young.

3. Like all public and general charities without the safeguard that personal knowledge affords, hospitals tend to foster idleness, helplessness, and their natural results, pauperism and crime.

4. Hospitals, when badly constructed or badly managed, are liable to cause hospital-diseases among the inmates and become centres of infection, thus defeating the very object they are intended to promote.

On the other hand, the arguments in favor of civil hospitals are—

1. They are a necessity under many circumstances for giving shelter to the sick and helpless; and are supposed to be the most economical method of providing for the sick poor.

2. They are of very great value as affording opportunity for a comparative study of diseases, and for giving practical instruction in the science of medicine and the art of nursing, to the greatest advantage; thus, by helping directly a few individuals, indirectly rendering a service of incalculable value to the world.

3. During contagious epidemics they are a ready and practical means of providing for those who are in-

fects, and by their isolation preventing the spread of disease.

As means toward checking the undesirable multiplication of expensive institutions, to prevent hospitals from breaking up or interfering with the family tie, and at the same time to keep them from engendering pauperism, we suggest—

1. Do all that can be done to enlighten the poor to help themselves, and to avoid the causes of disease.

2. Give indirect help by improving the condition of the homes of the poor, by strict laws in regard to the existing condition, and the building of all dwelling-houses, manufactories, schools, etc., etc., and in regard to the sale of food, etc.

3. Limit hospital accommodations to those who have no homes and to those who cannot be assisted at their homes.

It is doubtful if the State can give out-door help, even medical help, without doing more harm than good; it can only be done wisely by establishing a Bureau of Intelligence for the supervision of charities in connection with the Police Department, with officers at each police-station, where the names and the numbers of the inmates in every house in the precinct or district would be known; and where a record, made from personal knowledge of all individuals receiving help, as to their circumstances, the amount of aid given, etc., would be kept. As far as possible, all help rendered should be guided by this personal knowledge; and it should be obligatory on all charitable institutions and associations to give information of all assistance afforded by them to individuals living in the

district. No help should be allowed to go unrecorded, except that given by a private individual as a personal gift.

Through this Intelligence Bureau, reliable personal knowledge of every applicant for hospital-relief could be obtained. We fully appreciate the great difficulty of organizing and uniting voluntary charities in this country, where there are so many different religious sects; but, by establishing such a system as the above, much could be done toward distributing help where it is really needed, and toward preventing indiscriminate charity and in detecting impostors.

To avoid the injurious moral effects of hospitals on the characters of the inmates, and to prevent such bad sanitary conditions in hospitals as are sure to result in prolonged cures, and often in the generation of fatal hospital-diseases, it is necessary to have hospitals constructed and managed in accordance with the teachings of social and sanitary science. The rest of this essay will be devoted to the purpose of showing how this can best be done in so far as sanitary science is concerned.

CHAPTER III.

ORGANIZATION AND MANAGEMENT.

MORE than four-fifths of all that we have been able to find written on hospitals is mainly about their construction. Since the appearance of Miss Nightingale's books, "Notes on Hospitals" and "Notes on Nursing," many articles have been written on "Hospital-Construction" and there have been endless discussions as to the best plans for building and for ventilating them; but rarely has the subject of organization or management been treated of. Many times the results of carelessness on the part of the doctors; unwise and fraudulent management; poor, untrained nurses; bad food; and general uncleanness, have been unjustly attributed to faults in the plan of construction. A well-managed, poorly-constructed hospital will give a far better result than a finely-constructed hospital with bad management.

The Board of Managers and the Medical Boards.—In this country we find our civil hospitals organized as follows: The governing power is vested in a board termed the trustees, managers, or governors, and in the case of a State or municipal institution called commis-

sioners. The members of these boards are usually business-men, wealthy merchants, bankers, etc. Now and then the name of a prominent medical man will be found among them, but, as a rule, the main elements represented in these boards are the business or financial and the philanthropic elements; while in the State institutions *politics* is the *ruling element*. Science is rarely represented in the boards of managers.

The medical board is generally composed of prominent medical men appointed by the trustees. A physician of eminence can easily get a position, but not infrequently hospital appointments depend more upon the influence an applicant can bring to bear upon the trustees than on his merits.

It would be supposed that the trustees naturally are guided by the members of the medical board in deciding upon the plan of construction, etc., when new hospitals are undertaken; but often the plans of the buildings have all been adopted before there is a medical board; and not infrequently, even when there is a medical board, the whole subject of construction is put into the hands of a committee of the board of trustees—a system which is apt to end in the adoption of a plan prepared by some architect; the result being a grand, monumental, architectural building, with all the “modern improvements” in it so as to enable the largest possible number of people to live in the smallest possible space.

The natural tendency of the architect's efforts is to produce an imposing and pleasing effect as far as may be compatible with the idea of making the most of a very small space of ground, for he is constantly at work devising the best plan to build houses in crowded cities

where every foot of ground must be made use of. The fault cannot be said to rest altogether on the shoulders of the trustees; they, no doubt, are guided by the knowledge they have on the subject, and it must be a very exceptional case where any other than conscientious, philanthropic motives would influence them. But business-men and politicians should not be expected to decide questions of sanitary science. Nothing in their training would lead one to suppose that they had the requisite knowledge. The difficulty is, that scientific men, especially physicians, do not take sufficient interest in such matters. Badly-constructed hospitals and dwelling-houses will be built, and the causes of disease will continue to create preventable disease just so long as doctors leave these matters to business-men and politicians and their architects.

For many years medical men have devoted their energies to discovering remedies with which to cure disease. Lately they have been, and are still, studying the results, i. e., the pathology of disease. Very lately the study of the causes, i. e., the etiology of disease, has attracted much attention; and we hope that soon there will be a more general and direct interest shown in the endeavor to prevent disease, the highest function of science in medicine. At present, medical men are too busy curing illness, to give much practical consideration to methods of prevention. Suppose the trustees who are about deciding upon a plan call in the members of the medical board to advise them: nine-tenths of the medical men, never having studied or even seriously considered the subject of hospital-construction, would be indifferent, or incapable of giving good advice, and the few who understand the principles, not being pre-

pared as to the latest views in construction, and being perhaps too busy with their own private affairs to bestow that time and special consideration on the subject which would enable them to give good advice, the trustees and architects are left to themselves to erect a badly-planned hospital.

In New York City, since 1865, the close of the war, six new hospitals have been built—the smallest of these, with the ground it stands on, costing about half a million dollars; and three of the six nearly, and one at least quite, a million dollars. Only one of these new hospitals can claim to be an improvement upon a hospital erected in Europe just fifty years ago on a plan proposed a hundred years ago, or can compare favorably with the first New York hospital, that was destroyed by fire a century ago; and only this one of the six has a building to show as an attempt toward fulfilling the principles which should be adhered to, and which were taught us by the experience of the late war. We mean the detached surgical pavilion at Roosevelt Hospital.

The progress in the construction of hospitals can be traced to scientific and medical men, aroused to a sense of duty by the ravages of pestilence or war, and to their indifference can with justice be attributed the fact that expensive buildings are erected for hospital purposes to-day, which from a sanitary standpoint would only be creditable to the middle ages. Some of the most eminent in the medical profession go daily to visit and treat the sick poor in hospital-wards, where, if they themselves were suffering from a compound fracture, or even an amputated finger, they could not be paid to remain for a day, on account of the danger of contracting that fatal disease, pyæmia, from the

atmosphere of the wards. If the medical board is not responsible for the *sanitary condition* of a hospital, who is? The trustees have never studied either sanitary science or medicine; they accept the reports of the medical board, without knowing that many of the deaths in their institutions are due to disease generated by the bad sanitary condition of the hospital. Examine closely the public reports of the medical boards of hospitals, and see how rarely they give any other impression than that everything is satisfactory, and exactly as it should be. Yet the statistics in some of these same reports will show a death-rate of one in every seven of all patients admitted, and that one in every fifteen of the deaths is recorded as due to hospital-disease.

It is obvious that such a condition of things would not be allowed to continue if the trustees or managers understood sanitary science. It has been proposed to give the medical profession a representation; but we believe that, if the members of the medical boards of hospitals would properly inform themselves, and exert their influence as they should do to bring about improvement, such a step would hardly be necessary. Since they do not, it might be a good plan to have the profession represented on the boards of managers, for then they could be held more directly responsible. But, under the present rules and by-laws of our hospitals, there are certain objections to the practical working of this plan. It is a well-known fact that every eminent physician has his set of favorites about him, who would get the appointments of honor. If the medical profession is to be represented in the boards of managers, then we must have a different method of making

appointments for the positions of attending physicians and surgeons; and, in fact, a change in this respect is at the present time very much needed, particularly in large cities where there are schools of medicine.

The Value of Hospital Appointments.—The position of manager or trustee to a hospital is seldom sought after; men of means and of social standing are usually selected and urged to fill the position. It is true, a man may accept the position to gratify vanity, but he would hardly seek it for the sake of remuneration, or as an important means of making a reputation and acquiring valuable experience in his business. On the other hand, an occasional request is made by hospital-trustees to be allowed to use the names of eminent medical men as consulting physicians or surgeons; but, it is not at all necessary for them to seek doctors of reputation and merit to fill the positions of attending physicians and surgeons to a hospital. Such positions, varying with the size and importance of the hospital, give a physician, with average ability, a chance to build up a reputation, secure a remunerative private practice, and gain an experience valuable on account of the very favorable opportunity for studying and comparing disease which nothing but a hospital could furnish, while the vantage-ground on which he stands enables him to secure a professorship which a better teacher could not get, because he could not give clinical lectures in hospital to the students.

“In Dublin,” says the *Philadelphia Medical Times*, “large premiums are paid for hospital appointments. In the Jervis Street Hospital five hundred pounds sterling—three hundred to the foreman incumbent and two

hundred to the hospitals—is said to be the customary sum.”

As long as a doctor is interested in medicine, he will usually retain his hospital appointment; if he is a teacher or professor, the position is essential, to enable him to give clinical lectures. Unless a physician holds such a place, where he can make the acquaintance of and teach the younger men of the profession his views, it will be a difficult matter for him to become a consulting physician, which is an enviable position for a physician, especially when his physical strength does not permit him to endure the active life of a practitioner.

Such is the value of a place on a medical board that many physicians are not satisfied with holding one hospital appointment, but take all they can get; and physicians with large private practice will be found holding two, three, four, and even more positions as visiting physicians or surgeons to different hospitals.

For more reasons than one, it is wrong for one physician to hold two or three hospital appointments at the same time. If he has a private practice to attend to besides preparing and delivering two or more lectures every week, it is utterly impossible for him to visit once every day his hospital-patients and do his duty toward them. Necessarily much of his work falls on the house-staff, and the patients must be satisfied with seeing the attending doctor pass hurriedly through the wards, stopping here and there to examine a case belonging to a class which at the time he is especially interested in, or perhaps an interesting case which he is going to bring before the students at his next lecture. For one to monopolize so many positions is an injustice to the rest of the profession. It may be from a sense

of duty, a genuine spirit of charity, that eminent physicians give their valuable time to the sick poor in hospitals, but it cannot be said to be charitable toward the rest of the profession for them to hold at the same time several very desirable positions which, if they are not worth anything to *them*, would be of great value to others.

If the trustees or managers of our hospitals would make it a part of the constitution or by-laws of the hospitals under their control that no physician or surgeon could hold the position of attending or visiting physician or surgeon to the hospital, and at the same time hold a similar position in some other hospital, they would do an act beneficial to the patients, as well as one of justice toward the medical profession.

Besides the above restrictions, and for exactly the same reasons, it would be well to limit the length of time during which any one could hold the position of attending physician or surgeon. Let the term be ten or fifteen years, so as to give each one a chance to receive the full benefits, and time sufficient to develop what talent he has in him. Even though it be a work of charity, it is hardly fair that one person should continue to do it, long after it has enabled him to reach the highest position to which his ability entitles him, and to the exclusion of others from a position without the advantages of which it is difficult for them to make use of, or even make known, what ability they may possess.

To every fifty patients, or every two wards, there should be a visiting doctor and one assistant visiting doctor on duty, and both of these should visit the wards once every day. The number of visiting doctors

could be increased by having a given season during which they would be on duty, alternating every four or six months with others of the medical board. To the same number of patients there should be three resident doctors. (*See Relation of the Medical School to the Hospital, in a subsequent chapter.*)

The Influence of Women in Hospitals.—Besides the need of scientific representation in the boards of managers, the want of another very essential influence is noticeable in hospital management.

Into the housekeeping, the laundry, kitchen, and nursing service of hospitals, abuses often creep and become permanent fixtures, because the inspecting committees, all composed of men, do not detect them. The wards, etc., may present a cleanly and orderly appearance, while many abuses lie concealed, which only an expert in housekeeping would discover. Prominent business-men are not experts in housekeeping, nor is it possible for men to equal women in this department, not only because they have not had the experience, but because Nature does not give them the gift.

Admitting that men can supervise the housekeeping and nursing of a hospital and secure their being economically done and to the eyes of an inspector well done, still, as a rule, institutions so governed will be wanting in one of the most desirable and essential particulars, namely, that gentle and refining moral influence which is seldom found outside of the house kept in order by a woman. Under men it might work as smoothly and noiselessly as a Corliss engine, but the good influence of human sympathy would be wanting, and the subordinates would do their work for what

they could "make" out of it, and in time would become hardened and in some instances cruel; their highest aim and effort being to please the superintendent by making a sufficiently good appearance to satisfy the visiting committee. The case is improved where female subordinates of good character are employed, but the influence to be effectual must come from the highest power. It is the management, whatever that may be, which gives the tone to the institution. Strict order and discipline will, or rather must, suffice in the housekeeping department of a man-of-war and of barracks; but in a hospital, to these, sympathy and kindness should be added. The nearer a hospital resembles what we understand as expressed by the word *home*, the better it is; and, to approach this, woman's influence must be felt, from the board of managers down to the coal-heaver.

How is it practicable to introduce this influence into the administration of hospitals? A separate board, composed entirely of ladies, to assist in managing, has been tried. This plan seems to work very well as long as the hospital is comparatively small; but, unless the different members of all the boards are well known to each other, misunderstandings are sure to arise, it being difficult to keep up harmony and unity of action between the board of governors, the board of lady managers, and the medical board. To obviate this complication, it has been suggested that there should be a limited number of lady members appointed on the board of governors instead of a separate board of lady managers, it being understood that the special duty of the ladies would be to supervise and direct the organization and administration of the house-keeping and nursing departments.

Five years ago the "State Charities Aid Association" was organized. The Association is "composed of ladies and gentlemen who propose to establish local visiting committees for the almshouses, hospitals, and other public institutions of charity throughout the city and State of New York." The objects are—"1. To promote an active public interest in the New York State Institutions of Public Charities, with a view to the physical, mental, and moral improvement of their pauper inmates. 2. To make the present pauper system more efficient, and to bring about such reforms in it as may be in accordance with the most enlightened views of Christianity, science, and philanthropy."

For five years the Association has been thoroughly organized and earnestly at work, and much good has been accomplished. The membership now numbers about twelve hundred. The ladies' committees regularly visit and inspect the hospitals and other public institutions. They have no direct authority, but indirectly they have great influence on the management and administration of these institutions. They have succeeded in introducing trained nursing by establishing a "Training-School for Nurses" in connection with Bellevue Hospital. This school, organized after the system inaugurated by Miss Nightingale in England, has proved to be a great success. The superintendent of the school is a lady, both by birth and education, and several of the fifty nurses and pupils, now at work in the wards of the hospital, are refined and educated women, who have taken up the work, not from necessity, but choice. The introduction of these ladies into the wards of this pauper-hospital has not only changed completely the moral atmosphere of the place, and re-

duced the death-rate, but promises to revolutionize both hospital and private nursing throughout the country. Already several schools have been organized in other cities and are working successfully. By means of these training-schools for nurses, the influence of women can be successfully introduced into hospitals. To every fifty patients there should be not less than ten trained nurses and student-nurses. (*See Relations of the Training-School for Nurses to Hospitals, in a subsequent chapter.*)

Both breathing and eating are essential to sustain life; but, since breathing must be kept up at all times, we may say that breathing is of more importance than eating. In the same sense we may say that nursing, which should be continuous, is of more importance to the sick than medical attendance.

The Superintendent.—The superintendent or executive officer of hospitals in this country is appointed by the board of managers, and to them he is alone responsible. In some cases the superintendent is a medical man, but not infrequently he is simply the business agent of the trustees, and makes it his aim to maintain as good an appearance of things as possible, and to please the trustees by keeping down the expense, without much knowledge of, or much regard for, the welfare of the patients.

In every hospital there are three legitimate interests:

1. Charity, or the humanitarian interest, which seeks to make the hospital serve the welfare of the patients; the motive being to have that done which will bring immediate personal good.

2. Learning, or the scientific interest, which would use the hospital for the purpose of studying and teaching the science of medicine; the motive being to have that done which in the future will do good to all mankind.

3. The material or economic interest, which would limit the expenses of the hospital; the motive being to make the wisest use of the funds. The guardians of the first and the third are the trustees, assisted by the nurses, medical men, and employés. The guardians of the second are the attending medical staff, assisted by the house-staff, nurses, and employés. These three interests, in a properly-conducted hospital, should not be conflicting; but there is a fourth interest that often shows itself in hospitals—namely, selfishness, or the interest of individuals, who strive to use the hospital for the purpose of adding to their profits or their reputation. It is this selfishness of individuals which interferes with the true interests of the hospital, and in most cases is the real originating cause of serious quarrels between the different parties representing them. Besides, through the want of comprehensive appreciation, and the natural tendency of individuals to become partisans, and to see things from one standpoint, and through personal misunderstanding and enmity, the representatives of the true interests of the hospital not infrequently become antagonistic.

The position of the superintendent, especially in a large hospital, to which is attached a medical school, is one of great importance. The superintendent should be, if not a Christian man, at least one educated in and guided by moral laws, otherwise he would not appreciate the humanitarian interests; he should be a person

educated in medicine and guided by the laws of health, otherwise he would not appreciate the scientific interests; and he should be a person who understands and is guided by the laws of economy, otherwise he would not appreciate the material interests of the hospital. Besides, he must be a person of executive ability and sound practical judgment, for it will be his duty to supervise and direct the employés, and to decide and adjust the numerous minor differences of all these interests.

Supposing the superintendent to be a man possessing a knowledge of and comprehensively appreciating the laws of morals, health, and economy, and having executive ability and practical judgment, what should be his position, and his relations with the trustees and the attending medical staff?

The trustees are the managers, the controlling board of the hospital. They should decide upon all the rules and regulations. By them all the duties and powers of the attending medical men and the superintendent should be defined and decided. They should reserve the right of revoking all rules and regulations defining the duties and powers of every one connected with the hospital.

The superintendent should rank in position with the attending physicians and surgeons, and have a seat at the meetings of the medical board, so as to be informed on all questions coming before them, and he should have a seat at the meetings of the executive committee of both the board of trustees and the medical board. All medical questions should be brought before the medical board for consideration, and for them to report upon, and their reports should be taken by

one of their number, with the superintendent, before the board of trustees for final decision.

All questions arising, which are not covered by the rules and regulations, should, if immediate action is required, be decided by the superintendent, whose decision should hold good till the matter is finally decided by the board of trustees.

Once every month, just after the meeting of one of the boards, there should be a joint meeting of the board of trustees or their executive committee with the members of the medical board, at which certain subjects should be discussed. One object of this joint monthly meeting would be to bring the members of the two boards into personal acquaintance, and thus prevent rumors and insinuations about individual members from having undue influence. It is not an uncommon thing, in large cities, to find trustees and the attending medical men of the same hospital, personally strangers, knowing nothing of each other, except by reputation and report.

To be educated as a physician implies that a man has studied the subject on which sanitary science is based; but it is rare to find a doctor who is a sanitarian; in fact, many doctors seem never to have directly considered the subject. The superintendent, therefore, besides being a medical man, or one educated as such, should be a good sanitarian, and one who has given special study to hospital-construction, and who has some knowledge of mechanics and civil engineering. It is useless to depend upon a committee of inspection appointed from the members of the medical board, whose duty it would be to supervise the sanitary condition of the hospital. They are men too busy

to attend to the work, even in a routine way, and they never think of studying up sanitary subjects. The duty of the superintendent would be the constant personal supervision of the hospital, especially in regard to its hygienic and sanitary condition. In a large hospital, under the superintendent there should be a steward, whose duty it would be to take charge of the accounts and supplies of the hospital; a clerk, to have charge of the recording of admissions and discharge of patients, and the books in the office; a warden, to watch the male attendants, and to have charge of the police of the hospital; and a lady superintendent of the nursing, diet, and cleansing, of the hospital.

An important duty of the superintendent would be to carefully supervise the construction and repairing of all buildings. Let the plans be never so well prepared, numerous questions will arise, which can only be decided by a superintendent of the qualities described above. Unless such a person is on the spot while the work is going on, many opportunities will be lost for making minor and sometimes radical and essential changes in the carrying out of the plans. On this account, it will be of the greatest importance to select the superintendent before the work of building the hospital is commenced.

The superintendent must be a man of position and ability, and one who can be trusted with authority; otherwise he will be made a tool of, and will serve the interests of some individual or clique, instead of those of the hospital. Any attempt on the part of the trustees or others to employ a superintendent of inferior capacity, and to depend on supervising the hospital from the outside, will result in failure.

For the details of internal management we refer our readers to the "Hand-Book for Hospital Visitors," document No. 13 of the State Charities Aid Association. It is a book of one hundred and fifty pages, very complete and practical, and supplies a want in hospital literature. It will rank with Miss Nightingale's "Notes on Nursing," and is more direct and better adapted for use in hospitals.

CHAPTER IV.

THE CONSTRUCTION OF A CIVIL HOSPITAL.

WE have said that a poorly-constructed hospital well managed will give better results than one well constructed but badly managed; now we add, that a properly-constructed hospital properly managed will give still better vital results and at the same time can be managed with greater ease and economy.

The conservative and, in some cases, more or less interested hospital authorities, who for years past have opposed a change in the construction of hospitals, now claim that with intelligent and well-trained nurses, together with the adoption of Lister's antiseptic method of dressing wounds, pyæmia and other hospital-diseases will no longer occur, and therefore the necessity for replacing the old, massive, many-storied hospitals with those of modern construction no longer exists. It would be well for those who so strongly resist any proposed change of the old buildings, to study the history of training-schools for nurses, before they undertake to use the good influence of trained nurses as an argument in opposing further improvement, for they will discover that the advocates of improved plans of construction are the very founders of these schools, and that it is

through their efforts that trained nursing has been introduced. We know full well that trained nursing and good management will modify bad hospital influences; and that, if the antiseptic method of dressing wounds after Mr. Lister's teachings is efficiently carried out in all its details, pyæmia will occur less frequently and the death-rate in hospitals will thereby be lessened: still, foul air will continue to do harm by prolonging convalescence and reducing the general health of patients, thus extending their stay in hospital, and rendering them more liable to a relapse, and always depriving the patients of a certain amount of power to resist successfully disease. Every one knows that a man may not starve to death on poor food, but that good food is much better, for it renders him less likely to contract disease, and gives him strength to resist its fatal tendency. Exactly the same is true of air.

Good management, trained nursing, and improved medical and surgical skill, may reduce the death-rate, and to a great extent counteract the evil effects of bad air; but these are no justification for the existence of poorly-planned hospitals. Saying and even proving, were that possible, that pyæmia and other diseases caused by foul air occur in private practice equally as often as in hospitals, should not prevent us from bringing about a change in hospital-building which should rid us of these evils; from a sanitary standpoint it would be absurd to assume, as this comparison requires us to do, that our private houses are properly constructed.

If a ward is carefully sealed up and filled with steam, and several bushels of chloride of sodium and the black oxide of manganese are mixed and spread

out in lead pans placed on the floor, and if then several carboys of sulphuric acid are poured on, thus generating several tons of chlorine gas, and the ward is kept closed for twenty-four hours, undoubtedly that ward may be said to be thoroughly disinfected, or at least the disease-germs are rendered inert for a time. But the very fact that the ward has become infected to such an extent as to render this process necessary is the strongest possible argument against the fitness of the ward for the inhabitation of the sick.

Admitting that disinfection not only renders inert but actually destroys the disease-germs, as patients cannot live in an atmosphere of chlorine gas, nor in that of any other disinfectant possessing sufficient power to even render the germs inert, therefore disinfection is only a palliative, and not a preventive measure. "An ounce of prevention is worth a pound of cure" is a proverb equally as applicable to an infected hospital as it is to disease in man. Removal of the cause of disease is the first law in sanitary science, and the more nearly this law is followed in hospital-construction the better the results will be.

We will assume that it has been decided to establish a general hospital, say, of four hundred beds for the purpose:

1. Of giving to the sick poor better care and attention than they can otherwise command while sick.

2. To afford the medical profession of the community an opportunity of studying and teaching the science of medicine, to the fullest extent that this can be done without in any way interfering with the welfare of the patients.

3. To afford those desirous of becoming nurses the

opportunity of being taught and trained as nurses to the very best advantage.

All contagious and infectious cases are to be excluded as being dangerous to others. No maternity wards are to be connected with the hospital, on account of the great danger to lying-in women of their contracting puerperal fever when treated in wards connected with a general hospital.

The hospital is for general medical and surgical diseases, and such special diseases as are in no way dangerous to others, and as can be conveniently treated in connection with such an institution. There is to be a limited number of beds for the use of strangers, and others without homes, willing to pay for hospital treatment.

Location.—The first thing to be decided is the location. In a small city or town there is no question as to whether the hospital should be placed in the midst of the town, or outside in spacious grounds; but in large cities many objections are made to the hospital being removed from the centre of population. It is claimed that the sick cannot be safely transported, and on that account the hospital must be in town. The real difficulty is that, if the hospital is out of town, the managers and attending physicians and surgeons are inconvenienced, and in the case of the doctors it would be hardly possible for those in full practice to leave town every day. Then, too, the medical schools are in town, and, if the hospitals are out of town, clinical instruction would be attended with difficulty.

In answer to this we would say that in large cities where the streets average not more than fifty or sixty

feet in width, unless a hospital can be in the centre of a large park, it should be placed out of town for the following reasons:

So as to give the patients the advantage of pure air—doctors send their private patients out of town to get the benefits of pure air; to free the hospital and its grounds from surrounding obstructions to the free circulation of the outside air; to remove the hospital from sources that render the air impure, such as *large sewers*, manufactories, the filth, dirt, and dust, of the city streets and houses, etc.

On the ground of economy; the land is cheaper, and this permits the erection of cheap one-story buildings in place of costly, many-storied structures.

As to the question of transportation, the improved ambulances and other means of conveyance practically do away with the difficulty when combined with a system of small reception-hospitals, one or more as the circumstances demand, of a few beds each, where emergency-cases could be received and treated until able to be carried to the general hospital.

As to the inconvenience to the managers, if they are working for the welfare of the patients, then they should do their duty, or give way to others who would. The attending doctors who are expected to treat the cases should not be men with very large private practice; whether the hospital is in or out of town, they cannot well spare the time to do the every-day work. Such men, if they will hold the hospital positions, should have assistants to do the work that they have not the time to do.

As to the medical schools, the question is of more importance; but, under a better system, where the

clinical instruction is confined to the more advanced students, the difficulty would not be so great.

Whether in or out of town, the site of the hospital should be selected as having the best natural advantages; and these are: a porous and well-drained soil and subsoil, with southern exposure, and with protection, in our climate, from the north and east winds, but in no way affected by receiving the drainage of higher ground; lastly, sufficiently removed from swamps, ponds, or any source of malarial emanations.

Preparation of the Grounds.—Unless the soil is remarkably well drained by nature, deep subsoil drains should be laid with great care so as not to interfere with the foundations of the different buildings, but at the same time take every advantage of the natural lay of the grounds. Whether such drainage of the ground is necessary or not, on account of the nature of the soil, it will be an advantage, if properly done, for porous earth (and well-drained ground is porous) is one of the very best disinfectants, and naturally absorbs noxious gases, and thus tends to purify the air around the hospital.

In large cities sometimes it becomes a necessity to erect one or more small reception-hospitals in crowded districts; but not infrequently large hospitals will be built in locations where they should not be, and on badly-drained soils. To modify the inevitable evil of insufficient and impure air, when a hospital is built in a crowded district surrounded by blocks of houses, etc., which obstruct the free circulation, an additional space should be allowed, both within and without the wards, to each patient; and if the soil is damp, besides the

effort to drain it, it would be well to raise the whole surface by adding several feet of suitable earth, and by all means to put the wards on raised foundations and cover the surface beneath them with concrete and asphalt, and leave the space open to the sun and air.

Character of the Buildings.—The site being selected, the next thing to do is to determine the character of the buildings to be placed upon it.

More than a hundred years ago it was very clearly shown that a large number of sick people should never be assembled under the same roof, as it is impossible to supply each patient with the requisite amount of fresh air on account of the large quantities of poisonous gas thrown off from the lungs and emanating from the bodies, the wounds and excretions of the patients, and continually infecting the air; that in a large building the foul air of one part could not be prevented from permeating the whole structure—in this way one infectious case being liable to infect all the inmates; and that in a large building it was difficult to give each patient sufficient sunlight. To obviate these difficulties it was decided—1. To divide a large hospital into a number of small buildings; 2. That the administrative offices, the apartments of the officers and servants, the stores, drugs, etc., should be in a separate building from those containing the patients; 3. That the separate buildings, or pavilions containing the sick, should each contain only two or three wards, and the rooms or wards in which the patients were to be treated should have a limited number of beds in them; 4. That the wards should be so constructed as to give each patient a large cubic space of air, and by means of opposite

windows, etc., to admit of easy ventilation and plenty of sunlight; 5. That each ward should have certain necessary accessory or service rooms connected with it; 6. That the buildings or pavilions containing the patients should be separated some distance from each other and all other buildings, and connected with the administrative building and the other pavilions by a corridor or simple inclosed passage-way.¹

These principles were plainly and definitely given in the report of the committee appointed, from the members of the French Academy of Sciences, to decide upon a plan for rebuilding the Hôtel-Dieu as early as 1786.

Notwithstanding the fact that previous to 1860, with only three or four exceptions, civil hospitals were not constructed in accordance with the above principles, still, since the completion of the Lariboisière in 1854 on the plan proposed by the French Academy's committee, the above ideas have been in the main accepted, and in most of the hospitals erected after 1860 they have been carried out with various modifications, while, since the appearance of Miss Nightingale's book, the "pavilion plan" has become very popular. Accepting the above principles, we proceed with our plan.

Classification of the Patients according to their Diseases.—We do not accept the usual custom of having one plan of wards for all the patients of a general hospital, and, since the character of the ward is to depend upon the class of diseases to be treated in it, we will first indicate a general system of classification:

¹ We refer our readers to Miss Nightingale's book, "Notes on Hospitals." In it will be found the best argument in favor of the pavilion plan and against the old, massive, many-storied hospital-buildings now in use.

CLASS I.—Non-infected cases and those not liable to become so or to infect others—as rheumatism, diseases of the heart, liver, kidneys, etc.

CLASS II.—Non-infectious cases and not dangerous to others, but liable to become infected—as slight wounds, scalp-wounds, with slight fracture of skull, etc.

CLASS III.—Non-infectious, but liable to become so, and dangerous at all times to others—as sloughing wounds, burns, etc.

CLASS IV.—Infectious and contagious cases—as pyæmia, septicæmia, erysipelas, gangrene, etc.

The Ward.—Shall each ward be in a separate pavilion, or shall there be two or more wards in each pavilion?

No one will attempt to deny that one-story pavilions are more easily ventilated and have proportionately a greater surface exposed to sunlight than a building of two stories, and that the isolation of the patients of a one-story ward is more complete than it is practicable to attain in a pavilion containing two wards.

It is said that one-story pavilions are more expensive: because, to build a hospital of one-story, more ground-space is needed than for two; that two pavilions of one story are more costly than one pavilion with two wards, as there are an extra roof and foundation; that the administration is more difficult; and that it requires more fuel to heat wards in separate, one-story buildings.

In answer to the first objection as to the ground-space, we would say at once, if there is not sufficient ground for one-story buildings, then do not put up so large a hospital, or select another site where land is

cheaper; having, if necessary, small reception-hospitals and ambulance-wagons to transport the patients. It is by no means certain that wards, one directly above the other, are better placed than when separated, even though the space between is not great. It is claimed that germs float horizontally. But we know how soon the outside air will dilute and dissipate foul air; besides, we know that almost all building-material is permeable to air which readily passes from one chamber to another, although there are no communicating doors.

In answer to the second objection, as to the cost of building—it is true there must be an extra roof and foundation, but the foundations need not be so deep nor the walls so heavy in one-story as in two-story buildings, and there are no expensive stairways or elevators as in the two-story buildings. We have examined the contracts of various hospitals, and we are satisfied that one-story pavilions are but little more expensive as hospital-buildings than two-story pavilions, and not so costly as buildings of many stories.

The new pavilion of the New York State Woman's Hospital of three stories and an attic, to contain between sixty and sixty-five or seventy-five beds, has already cost \$108,000, and it is estimated that \$30,000 more will be required to finish it; and the New York Hospital now being completed is a building of seven stories, to contain a hundred and fifty beds. The contract for the building alone is \$432,000. This gives for the Woman's Hospital pavilion a cost for the building alone of \$2,143 to each patient, and of \$2,836 for the New York Hospital. The contract for the building of the one-story pavilion of the Presbyterian Hospital of Philadelphia for twenty-eight beds was only \$12,000,

or a cost of \$428 for each bed. The heating apparatus and furnishing made the total \$15,000, or only \$535 for each bed.

Those who have had charge of hospitals of one-story buildings claim that, as all the wards are on a level, the administration is easier; there are no stairs to keep clean and ascend, nor elevators and lifts to work. We admit that it requires more fuel to heat the one-story wards, but we do not consider this an objection—on the contrary, an advantage; if fresh air enters the ward so rapidly, then we can be sure that the ventilation is more perfect. In very cold climates double walls, double roofs, and plate-glass windows, can be used.

Our conclusion is that, for the treatment of all the classes of patients we have enumerated above, it is desirable to have every ward in a separate, one-story pavilion. For the treatment of cases coming under Classes II. and III., it is essential that the wards should be in one-story pavilions. For the treatment of Class IV., isolated huts or tents are absolutely necessary.

Shall the Buildings be permanent or temporary in Character?—The ancient Jews recognized the fact that leprosy would infect the walls of a house, and that it was necessary to scrape and purify the walls, and in some instances entirely destroy the house, to prevent the spread of the disease. And it is an undisputed fact that certain infectious diseases will poison at least for a time an apartment so as to render it dangerous as a habitation; that every case of these infectious diseases evolves poisonous matter, or germs that are liable to cause the same or a kindred disease in other persons; that if not all, at least many, of these disease-germs, are

conveyed from one person to another by means of actual contact of clothing or other material which has been on or about the person infected; that the poison is spread by the air itself becoming poisoned, or in some way conveying the poisonous matter or disease-germ; and that air charged with these germs or particles is liable to deposit them on all surfaces, and in all the openings, crevices, or pores, into and through which it permeates. Now, the latest and most reliable experiments on these infectious germs or particles show that time has but little, and in some cases no, apparent effect on their vitality or power to reproduce disease, and that the substances known as disinfectants cannot be said always to destroy, but only to prevent for a time, the process of fermentation or decomposition, or the development of those conditions which seem to be essential to the active state of generation and propagation of the poison. To have even this influence, the disinfecting substance must be of a certain strength, and be made to reach each particle or germ.

The conclusion is, that practically the majority of so-called disinfectants do nothing more than substitute one odor for another, and that many of them when thoroughly applied can only be relied upon to allay for a time the active condition of disease-germs. Without question intense heat of several hundred degrees, and certain strong corrosive substances, can be made to destroy these poisonous germs; but, both experience and experimental science show that in many cases, to completely destroy these germs, without at the same time injuring or destroying the substance or material infected, is impossible, and that practically the task is so difficult that it is better to remove, and not infre-

quently it is best to destroy, the infected substance or material.

It is a well-known fact that nearly all building-material is permeable to air. Lately Pettenkofer has shown by experiment that a difference of temperature in the air of a closed room from that of the outside air causes a free flow through the walls of the room, and that the quantity of air passing through varies according to difference of temperature, or inequality of atmospheric pressure, and the character of the wall; but that through all walls more or less air will pass, and that the quantity of air that will pass through an ordinary brick wall, with the usual plastered surface, is very great. He says that in the case of an ordinary room, with the windows and doors closed, with an open fire burning, more than half the air that enters the room and passes up the chimney comes directly through the walls.

If it is true that infectious germs are floating about in the air, and that the walls are permeable to air, then it is easy to understand that the walls of an apartment would be liable to infection. There are facts that go to show that walls do become infected with the poison of disease. One striking instance is that which occurred in 1864, when a ward in which fever-cases had been treated in the old New York Hospital was being renovated. "Out of five masons who were removing the plaster, three died of fever in a few days."¹

We do not doubt but that perfect cleanliness and careful attention to ventilation, etc., will do much to prevent the infection of the walls, and to obviate the

¹ Mr. J. W. Beekman's "Centennial Address" before the Society of the New York Hospital.

danger when they are infected; still many cases will arise where the saturation of the walls of a building in which a number of infectious cases have been treated is such as to demand complete destruction. Disinfection and purification by exposure to the weather may for a time remove the danger, but cannot be relied upon as certain and lasting preventives. Practically it is a very expensive and difficult matter to secure impermeable walls; and even if walls could be made impermeable to air, it is doubtful if they are desirable, on account of preventing a free circulation of air through them, and thus interfering with ventilation.

In answer to the question "Should the *wards* (not the entire pavilion, for we have the service-rooms in a separate building) be permanent or temporary in character?" we would suggest that the pavilions for the first and second classes of cases enumerated be permanent in character, but that those for the third class should be more or less temporary; those for the fourth class, of course, to be frequently destroyed and renewed.

Number of Beds to each Ward.—Giving full consideration to the number of sick that should live in one room, and to economy in having them properly attended to, from twelve to thirty-two has been found by experience to be about the range.

Just as the character of a ward should depend upon the class of disease to be treated in it, so should the number of beds in each ward vary with the class of disease to be treated in them.

For medical and other cases not infectious or liable to become so, we would place the number of beds at

from twenty-five to twenty-nine; for surgical and other cases not infectious but likely to become so, from nineteen to twenty-five; for severe cases extremely liable to become infectious, and always dangerous to others, the number of beds to the ward should not be more than from twelve to sixteen.¹

Infectious and contagious cases in connection with a general hospital should be at once removed to tents or huts containing not more than from two to four beds. The number of beds should by no means be the same as the number of patients in every ward, especially when two or more severe cases are in it. There should always be at least three or four beds empty, so as to give time for changing and cleaning them, and so that the beds adjacent to any special cases could be left vacant.

The Cubic Air-Space to each Bed.—In regard to the air, the important point is to insure a rapid, constant, and complete change of the atmosphere surrounding the patient, and to effect this without causing hurtful draughts. For the convenience of administering to the wants of the patient, it is essential to allow a certain amount of cubic air-space and surface area. About 1,800 cubic feet of air-space, with a surface area of 124 square feet, has been adopted as the space required. We would have the space vary in accordance with the class of disease to be treated in the bed.

The dimensions of the surgical ward containing twenty beds should be the same as the medical ward

¹ The above figures are given supposing the dimensions of the wards for all three classes to be the same, thus giving more than double the cubic air-space to the third class than is allowed to the first class.

for twenty-five beds, and the ward for twelve dangerous cases should be the same size. Thus, say that 1,800 cubic feet in the medical ward are allowed for each bed, the allowance in the surgical ward would be 2,160 cubic feet, and 3,600 cubic feet in the ward for dangerous cases.

Shape of the Ward.—The shape of the ward usually recommended and very generally adopted is that of a rectangle, with a width of from twenty-four to thirty feet, and a length varying with the number of beds, usually about three times the extent of the width. The height commonly adopted is from fourteen to sixteen feet.

Within the last four years, two wards have been constructed in connection with the Massachusetts General Hospital at Boston, one of which is forty-four feet square and the other forty-five by fifty-five. The square ward has some advantages over the elongated, rectangular form; but, except in those cases where the number of beds in the ward is so small that the square would not be more than thirty feet, and at the same time allow sufficient air-space, we would give the preference to the elongated ward.

It is true that in the square ward the fireplaces or stoves, and the ventilating-shafts, can be placed in the centre of the ward, and thus be more nearly equidistant from all the beds, whereas in the long ward two such shafts are necessary, and that in the square ward the patients are all nearer, and more convenient to the service-rooms. But in the long ward there is more wall-space, and therefore the beds are not so near each other, as in a square ward of the same capacity; and if the square

ward exceeds thirty feet, there is a greater volume of air to be moved* between opposite windows, the sunlight does not so completely reach all parts of the ward, and the surface of the ground beneath is further removed from the purifying influences of light. In the square ward the patients are nearer the service-rooms, but at the same time they are more in danger of infection from that source. Then, too, if the service-rooms are attached to one of the four sides of the ward, one-fourth of the whole wall-surface is cut off from the outside air.

We would make the ward thirty feet wide, fifteen feet to the roof at the eaves (the roof having a slant of not less than thirty degrees), and long enough to give for the medical ward nine feet of wall-space to each bed, for the surgical ward not less than ten feet, and sixteen feet for the ward for dangerous cases.

Position of the Ward in Relation to the Points of the Compass.—If the long, rectangular ward is adopted, then it is essential that the long axis of the ward should be from north to south, so that the sun will shine half the day on one side, and the other half on the opposite side, thus exposing the largest possible surface to the influence of the direct rays of the sun.

Position of the Service-Rooms.—The usual plan is to attach the service-rooms of the ward directly to the ends of wards; the nurse's room, dining-room, ward-kitchen, and extra room or small ward containing one or more beds, being attached to the end of the ward nearest the corridor, being in reality a part of the ward partitioned off with a hall-way through its centre and

connecting directly with the corridor which is usually on the same level as the floor of the ward. At the other end of the ward, in the corners, the water-closets and bath-room are usually placed, being cut off from the ward by lobbies. In some cases the ends of the wards containing these service-rooms are widened so as to leave a broad passage-way between them, at the end of which there is a large window.

The service-rooms should be separated from the ward and in a distinct building, placed at the north end of the ward, and connected with it by means of a short corridor. This corridor, or short passage-way, should project from near the centre of the service-room building until it reaches a point when, by a turn at right angles, it could connect with the ward, opening into the ward on the side in the corner. This short passage-way should be about six feet wide, so as to allow a man to be carried through it on a stretcher. It should be carefully guarded by swing-doors where it turns at right angles and where it enters the ward, so that it would be impossible for a current of air to circulate through it from the service-room to the ward, and it should be well lighted and carefully ventilated. Thus we have the ward completely isolated.

The objects aimed at are—1. To avoid the danger which is to be apprehended from the proximity of the numerous partitions, doors, etc., of the service-rooms as affording places for harboring infection, and from the emanations from water-closets, drains, sinks, and dining-rooms; 2. To diminish the risk of the foul air of one ward reaching other wards by means of the corridors; 3. To leave the ends of the ward free, so that a current of air can pass through the ward as readily from end to

end as from side to side; 4. That if need be, on account of the ward's becoming infected, it can be destroyed, leaving the basement and service rooms and the corridors intact.

In a long ward it is very important that its ends should be free, so as to allow a current of air to pass freely and without the risk of bringing infection from the service-rooms, for in all long, narrow chambers the natural current of the inclosed air is in the direction of the long axis, being that of the least resistance. Besides, during the summer months, when the windows are open, the prevailing winds in our vicinity are from the south, and a current of air passing from end to end moves a volume of air in the ward through an open end-door or window, equal to at least three times as much as one passing through a window from side to side.

The Foundation of the Ward.—The foundation of the pavilions of a temporary hospital, such as is needed during a war, may be of a very simple character; but in a fixed, civil hospital the foundation should be carefully prepared, especially if the soil is not just what it should be. The ward should rest on pillars of masonry seven or eight feet above the level of the surface of the ground, and arched, so that the floor of the ward would rest on an asphalt and concrete surface to give it firmness and protection from cold. If the pillars are of brick, they should have layers of slate in each to intercept the passage of ground-air up through them. The surface of the ground beneath the ward, between the arches and for several feet around the building, should be covered with several inches of concrete and asphalt, and left open to the air and sun; for we know that air

circulates freely in the ground, and that a heated room, when the doors and the windows are closed, draws air directly from the ground; and that, as malarial and noxious gases float near the ground, there is constant danger of such gases being drawn into the ward.

In very cold weather, if necessary, glass sashes could be placed so as to close the space beneath the wards, but it should not be kept closed, for we believe all *cellars* and closed chambers of air, especially without the influence of sunlight, to be injurious. The air confined in such chambers becomes stagnant and prolific of myriads of low grades of life, or living organisms, which by decomposition soon infect it with poisonous matter, and, when the chambers above are heated, this foul air is sucked up into them through the walls and floors. If the space beneath the ward is left open and covered with concrete and asphalt, danger from the ground-air is entirely prevented.

Material for building the Walls of the Ward.—The walls of the permanent wards should be of well-made brick, with an air-space between the inner and outer surface so arranged as to connect with the space between the roof and ceiling, and be easily ventilated and, if necessary, fumigated. We would give the preference to bricks over wood, and to wood over stone, unless the stone was porous and easily worked. As wooden walls are cheaper than brick, we would use wood in constructing the wards of a temporary character. Walls of wood should be double, with an air-space between; this is necessary in severe climates to keep out the cold, and in warm climates to prevent overheating. In warm cli-

mates the space between the walls should be arranged so as to be easily ventilated and fumigated.

Should the walls of the wards be left permeable, or an attempt be made to make them impermeable to air?

The object in making the walls impermeable to air would be to prevent them from becoming poisoned with disease-germs, or infectious particles, or gases.

The object in leaving them permeable to air is to allow a free circulation of air through them. It is claimed that the constant passing of the air through the walls is an important part of ventilation; that to make the walls of our dwellings impermeable to air would be as objectionable as to wear a rubber suit all the time. Walls saturated with water are impermeable, and it is said that this fact accounts for the unhealthiness of houses with damp walls.

Besides interfering with ventilation, the expense of making the walls impermeable to air is very great, and practically very difficult to accomplish. Keen's cement and Parian cement have been found about the best substances for wall-finish. Tiles and preparations of glass have been proposed, and we have suggested sheet-zinc, or sheet-iron plated with zinc, as a good material.

So far as impermeable walls, or walls supposed to be impermeable, have been tried, in Lariboisière and St. Thomas's Hospitals, except that of being more easily cleaned than the ordinary "hard-finish," certainly no advantage can be claimed for them; the practical results on the patients, so far as reducing the death-rate, cannot be perceived.

It is very desirable that this question of impermeable walls should be tested by carefully-conducted experiments and *trials* made under similar circum-

stances. But since experience has shown that excellent results—and, so far, better than in any other kind of building yet tried—can be attained by treating disease in simple one-story buildings with the ordinary walls, we would adopt the ordinary “hard-finish” for the permanent buildings, and have the walls, when well settled and dried, painted and varnished to the height of six feet from the floor. For the walls of the temporary pavilions the same or a cheaper material could be used. Whenever the wall-plaster shows signs of age by cracking or giving way, the plaster should be completely renewed, and it would be well, at intervals, to scrape and renew the “hard-finish” in the permanent wards, and to frequently give the walls of the temporary wards a coating of kalsomine, and those for dangerous cases a whitewashing after a thorough fumigation.¹

The Floors of the Ward.—The floors should be laid on a firm foundation, so as not to spring or give, and create cracks. The space between the beams beneath the floor should communicate with the space in the walls so as to admit of ventilation and fumigation. In Europe oak seems to be the best material, but in this country the best hospital-floors we have seen are made of closely-joined Georgia pine. The reason why our oak floors are not usually good is, that the *Quercus alba* variety is the only oak-wood which will make good floors, and it is very scarce here in America.

¹ Mr. Dougall, of Glasgow, claims that the presence of alkaline substances induces decomposition of organic matter; and he asserts that the alkaline walls of hospitals, and the soap used in washing, tend greatly to produce infectious germs and thus cause pyæmia and other hospital-diseases. If this proves to be true, then a complete change must be made in the character of the walls of hospitals now in use.

If pine is used, every plank should be carefully selected as being well filled with resin, avoiding those pieces in which after a little use the soft part will wear away and the hard layers shale and splinter off, leaving holes. Shaling does not depend upon the quality of the pine, but upon the direction in which the saw cuts the annual rings; the saw should run as nearly as possible in the line of a radius from the centre of the log, to turn out good flooring-planks.

The floors should be kept smoothly polished, waxed, and rubbed, so as to make them impermeable to water and easily cleaned without daily or frequent scrubbing.

The Windows.—There should be one window to each bed. The height of them in all of the wards should be from within two feet of the floor to within one foot of the ceiling where it joins the wall. The width need not exceed three feet in the medical and permanent wards, but should be *full* three feet in the temporary wards, and still wider in the wards for dangerous cases.

All the wood-work, of which there should be as little as possible about the windows and in the ward, should be of hard wood, with all corners and edges beveled off and every part of it kept well waxed and polished. The window-sills should be of slate or stone.

For the sashes thick plate-glass, or single sash with double glazing, is necessary in cold climates, and is preferable to double sashes of small panes of thin glass. Both sashes should be made to slide easily. The blinds should be on the *outside*, and by a simple contrivance could be worked from the inside without opening the window-sash. In one-story pavilions with ridge-venti-

lation, louvres over the windows are not necessary, but a narrow panel ten inches deep and as wide as the door, just above the upper sash, should be hung with hinges at the bottom, so that it would pull out at the top and direct the air upward on entering the ward.

We would place the windows directly opposite each other. Alternate windows, or windows put opposite to the wall-space on the other side, were tried in some of the temporary army-hospitals in Paris during the late Franco-German War. If a large ward had only a few windows in it, such a disposition of them would be an advantage, but, when they are as numerous as we propose, we see no advantage to be derived from it.

The Doors and Roof.—In a ward there should be three doors: one opening into the short corridor which connects with the service-room building; the others, one in each end of the ward, with a window on either side. The doors should also be made of hard wood, perfectly smooth, without mouldings or panels, and kept well polished.

The roof should be of slate, with an air-space between it and the ceiling of the ward. This space should communicate with the space in the walls, and be arranged so as to be easily ventilated and fumigated. The ceiling should not be flat, but slope up and slant parallel with the roof, and be rounded at the ridge and where it joins the wall, so as not to have angles. The wall in the four corners of the ward should be rounded in the same way.

The Piazza.—The door in the south end of the ward should be wide enough to permit a bed to pass

through it, and should open on a piazza in summer and a glass sun-room in winter. A platform or flooring, the width of the ward, and projecting out twelve feet, with a simple framework, over which an awning could be stretched in summer and incased with sashes of glass in winter, would be all that would be required. A stairway or an inclined plane should connect the end of the piazza with the ground.

THE SERVICE-ROOM BUILDING.

The service-room building should be placed near the north end of the ward, and separated from the ward by an open space of ten feet, and sufficiently at one side so as not to overlap the end of the ward more than one-fourth its width. In this position it would not interfere with the end-to-end ventilation through the ward, nor intercept the sunlight.

Dimensions of the Building.—To have a complete set of service-rooms for a ward of twenty-five beds, the dimensions of the building should be thirty-four feet wide from east to west, by forty-six feet in length.

The Basement.—The basement should be wholly above-ground, so as to make the floor of the service-rooms on a level with the floor of the ward. The basement of this building should be divided into apartments, for the heating apparatus, servants' bedroom, and store-rooms, and should have a room where the old clothes, boots, etc., and effects of the patients, could be stored while in the hospital. In this room there should be *open-wire* cages built round against the walls, one to each bed in the ward, with doors and locks, instead

of closed closets. In the end of this room, with a door opening on the hall in the basement, there should be an open-wire-work closet, in which brooms and dust-pans should be kept. The doors of this room should be made to fit very closely; for the window, instead of having glass window-sashes, should be guarded by iron bars, and arranged so that the rain would not beat in, and left open, in order that the old clothes, etc., should be continually exposed to the purifying influence of fresh air. A closed apartment filled with these old clothes, in a pauper-hospital, soon becomes a hot-bed of infection. It should be a corner-room, so as to have several windows, to prevent dampness. The stairway from the basement should be in the northeast corner, and be wide and easy of ascent, and ventilated by three windows, and should be cut off from the hall of the service-room building by a lobby with swing-doors.

The Service-Rooms.—The first floor should be divided into two parts by a hall eight feet wide passing through it from north to south. The south-end door of this hall opens into the short corridor which connects the service-room with the ward; and the door at the north end of the hall should open out on the top of the main corridor.

Wash-Room and Water-Closets.—On entering this hall from the ward, on the south, there should be on the left-hand side a door opening into a lobby, six by twelve feet, containing a sink and four or more basins for the use of the patients; the lobby should have a large window at the south end, and two doors besides the one opening on the hall, one of these doors leading

to the water-closets, which should be in a room eight by twelve feet, in the southwest corner of the building. The closets should be three or four in number, and in separate stalls, each stall having a window opening into the outside air.

Bath-Room.—The other door of the lobby should open into the bath-room, which is ten by fourteen feet, with a door opening on the hall, and two windows into the open air, having a movable bath on rollers which, if necessary, could be run into the ward, and two stalls, one for hot air, the other for steam-baths; the floor should be impervious to water.

Day-Room and Dining-Room.—Next to the bath-room on the same side of the hall, occupying the northeast corner of the building, should be the ward day-room, also used as a dining-room, and having a small scullery with a little stove for heating and cooking certain delicacies (a good gas-stove would be sufficient for this purpose), and a sink, etc. The day-room should be fourteen by eighteen, and the scullery six by fourteen feet.

An extra room or small ward for treating certain cases, which would be better alone on account of being troublesome to the other patients, should be provided. This room should never be used for isolating infectious or contagious cases. A door on the right, at the south end of the hall, should open into this extra room or ward, which should be twelve by eighteen feet, and contain two beds—only one to be occupied by a patient, the other to be used in case of the need of a special attendant. There should be two windows, one open to

the east and one to the south, and a ventilating open fireplace in the northwest corner.

Nurse's Room and Linen-Shelves.—The next door on the right of the hall should open into a room twelve by ten, in which should be open shelves—not closets to cover that which should not be there—for the necessary clean linen for the ward. This room should have a window opening into the outside air, and a bed for the ward-nurse, only to be used in case it is occasionally thought advisable for any reason that the nurse should not sleep in the nurse's home, or should remain near the ward on account of some important case.

Reception and Examining Room.—Beyond this room, on the same side of the hall, should be a room ten by ten feet, with one window arranged so as to give a good light. In this room should be an operating or examining table and a closet for medicines, bandages, etc., and a bed to be used by patients while recovering from the effects of an anæsthetic. This is the reception and examining room, also to be used for minor operations on patients, when it is not desirable to convey them to the operating-theatre.

Every door in the service-room building should have a large louvre over it, and be placed opposite to a door on the other side of the hall, so as to establish direct cross-currents through the building. The door leading into the short corridor should be low, not more than seven feet, the height of the short corridor, so that a large window could be placed above it, opening into the outside air. The roof of the service-room building should be a gabled roof; the walls of the building, like

those of the ward, being fifteen feet from the eaves. The ridge of the roof should be over the hall, with openings in it for ridge-ventilation; or, what would be better, there should be a small cap-roof running the length of and over the hall, with a space between it and the main roof; the space to be protected by movable glass sashes.

Such a service-room building as we have described should be erected with the permanent wards for non-infectious cases and those cases not dangerous to others, but, in connection with the temporary wards of only sixteen beds, the service-room building need not be so elaborate. A building twenty-six feet square, divided by a hall, and containing bath-room and water-closets, a small day or dining room, an extra small ward, used also as an examining-room, and a nurse's room, would be sufficient. The service-room building in all cases could be made permanent in character, for the ward could be removed and renewed without affecting it.

Great care should be used to prevent any contagious or infectious disease being treated in the small ward in the service-room building, otherwise it will become poisoned.

THE MAIN CORRIDOR.

Except where the severity of the weather makes it necessary that there should be a closed passage-way between the wards and the administrative building, a simple covered way with a track for tramway-carriages should be used, not only for the sake of economy, but for sanitary reasons. A long, closed passage is apt to have currents of air flowing through it in the direction of its length, which are not diverted to any great ex-

tent by opening opposite windows, and thus foul air is readily conveyed from one end of the corridor to the other, and will find its way into any building with which the corridor is connected.

Besides, a corridor running over the ground is always an obstruction to the free circulation of the air, and, when it is on the same level as the wards, which is usually the case, it is a very serious obstacle to the circulation of the outside air, and almost sure to convey the foul atmosphere from one ward to another.

If it is sunken below the level of the ground, i. e., is a basement corridor, then it is a chamber filled with air continually fouling itself, on account of being deprived of good ventilation and sunlight; and this foul air is being constantly drawn into wards, especially in the winter, when they are kept warm, and outside air is barred out.

If a corridor must be the means of communication between the buildings, then the wards must be on basements high enough to allow the corridor to be wholly above-ground, with *its top not higher than on a level with the floors of the wards*. This would remove the main objection to corridors as obstructing the free circulation; but if they have direct connection with the wards, or with a hall or lobby between the service-rooms which has a direct connection with the ward, there will yet be danger of their doing harm by carrying foul air from one ward to another.

It is to obviate these dangers that we have proposed that the wards should be on arched foundations, raised so that the floor of the ward is eight feet from the ground, and the service-rooms in a detached building connected by a short elbow-corridor guarded by

self-closing doors. The corridor with its floor on a level with the ground should be about eight feet high, so that its top, as we have said above, would be on a level with the floor of the wards, and be made to serve as a walk to be used in pleasant weather in passing from one building to another. The inside of the corridor should be about eight feet wide, and have a small tramway-track for carriages in which the food and patients could be conveyed. There should be numerous windows, and, except in very cold weather, those on the south side should have the sashes removed.

The corridor should connect with the *basement* of the service-room building on the north end, so that, to enter the ward from the inside of the corridor, it would be necessary to go into the basement of the service-room building, ascend the steps to the hall, and then go through the short elbow-corridor.

From the top of the corridor to the end-door of the ward there should be a bridge: during pleasant weather the patients could thus walk directly out of the ward, and take an airing without going either up or down stairs.

In one of the five essays suggesting plans for the Johns Hopkins Hospital, the author, accepting the idea of separating the service-rooms from the ward, has given a drawing in which the service-rooms are separate from the ward, but are left on the line of the ward, and connected by a short, straight passage. The objection to such a plan is, that the end-to-end circulation is still seriously interrupted, and the chance of a current finding its way from the service-room building into the ward is greater than when the service-room building is at one side, and is connected only by an elbow-corri-

dor. From the fact that the length of the ward and the hall of the service-room are on a line, there will always be a tendency to draw a current through the neck; besides, the air from the windows of the service-room can readily find its way into the end-windows of the ward.

The same author gives a drawing in which the main corridor passes between the ward and service-room building, the connecting neck being on top of it, thus obliging all passers-by to go through it. As the top of the corridor will be used during the greater part of the year for the general passage-way to the pavilions, the communication between the ward and the service-room would be very much exposed, and the patients would be subjected to unpleasant encounters with any one who might be passing; besides, the corridor would be so close to the ward that, during the winter months, air from it would be drawn up into the wards.

CHAPTER V.

WARMING AND VENTILATION.

WARMING an apartment would be an easy and very simple process, if it were not a necessity to have the air frequently changed or the apartment ventilated; and if it were not necessary to warm the air that enters the room, ventilating an apartment would be comparatively easy. During cold weather the two must work conjointly.

That system of warming and ventilating is the best *which can most rapidly and completely remove all foul air and replace it with air as pure and fresh as the normal atmosphere that passes over the building*, and at the same time keep the room at a comfortable temperature, and accomplish this without causing disagreeable or hurtful draughts, injuring the building, or disturbing the inmates, and at the smallest cost.

Since so many conditions must be fulfilled to secure perfect ventilation, it is easy to account for the great difficulty in attaining good ventilation, and to see why so many plans have been tried and why so many fail.

There are two distinct and opposite ways of changing the air in a ward: one is to draw off the foul air by suction exhaustion, and allow fresh air to be forced in

by atmospheric pressure. The type of the methods for ventilating by suction is the open fireplace.

The other way of renewing the air is by driving fresh air into the ward and displacing the foul air by the application of mechanical force. The type of the methods for ventilating by means of mechanical force is the fan-ventilator.

The term "natural ventilation" has been applied by writers on hospitals to the method by suction used in conjunction with the windows, and "artificial ventilation" to that by propulsion or the fan-ventilator. The terms "ventilation by exhaustion" and "plenum ventilation" are also used.

In ventilation with open fireplace the air enters directly from the outside and is warmed in the ward; but, when the fan is used, it is necessary for the air to pass through a channel and be warmed in cold weather before it enters the ward. On this account, when the method by propulsion is used, the following dangers must be guarded against: That the air before it enters the ward has not taken up any foul gas or substance; that it has not lost any of its oxygen or other elements; that it has not been expanded by heat without a proper amount of water being added; that it has not been detained in its passage long enough to become stagnant.

Air should not be allowed to stand still, especially in the dark. With the light on it there will be motion, for light produces heat, and heat causes expansion, and expansion induces currents, unless the heat is equally distributed, which is never the case. Air, like water, to keep pure and fresh, must be in motion. Air, when confined, in a very short time, from the germs that all air seems to contain to a greater or less extent, will foul it-

self by the birth, life, death, and decomposition, of animalcules, and soon loses its vitalizing power.

In ventilating by exhaustion all the foul air passes out by one or a limited number of channels, while fresh air enters wherever there is an opening and directly through the walls if these are permeable to air. It is estimated that in an ordinary house, with closed doors and windows, one-half of all the air enters through the walls.

In ventilating by propulsion all the fresh air enters the ward by one channel, or necessarily a limited number of channels, while it escapes from the ward wherever there is an opening, and through the walls if these are permeable to air. When the doors and windows are closed we can assume that half the air passes through the walls. Now, if the walls are permeable to air, and if there are organic particles and disease-germs floating in the air, it is very evident that, if half of this foul air is *forced* through the walls, the walls would be saturated in a very little while with poisonous matter, and that a strong wind impinging on the outside wall would be liable to force this poisonous matter back into the ward. Besides, such an accumulation of poison would always be a source of danger. Therefore, if the plenum or propulsion method is adopted, the walls of the ward *should be impermeable* to air; while, if the method by exhaustion or suction is used, the incoming air would tend to purify permeable walls instead of poisoning them.

In the suction method half the fresh air permeates and imperceptibly enters the ward, while all the fresh air in the plenum method comes through the air-ducts. Thus the fresh air in the plenum method would produce

much greater draughts than in the method by exhaustion. These draughts would be very objectionable unless the air was warmed before entering the ward, and even then would often be disagreeable. This fact also explains why the anemometer shows motion more readily in a room ventilated by a fan than in one ventilated by an open fire: it is commotion to a certain extent, and not the steady flow created by an open fire.

The open fire is troublesome, and causes dust and dirt; and, unless some plan is adopted by which a part of the heat that would ascend the flue is utilized, the open fire could be called expensive. But, by regulating the draughts and by using air-jackets, or hot-air chambers so arranged as not to bake the air, an open fire can be made comparatively inexpensive.

Practically the method of ventilating by the fan cannot be applied to each detached ward separately except at great expense; but one fan, by a long air-duct, must be made to supply several wards with fresh air, and to do this without in any way changing the normal condition of air is a great difficulty, especially in winter, when the air is heated before it enters the ward.

To obviate somewhat this difficulty, we would suggest that the air-duct from the fan to the wards, instead of being underground, and made of brick and cement, be raised several feet above the ground, and be made principally of glass. This would give it sunlight, and remove the danger of ground-air.

To prevent the air when heated before it enters the ward from becoming dry—as it will by expansion of its volume and consequent increase of its capacity to absorb water—the heated air, instead of passing over water for

only a short distance or having at one point steam-spray thrown on it while passing as is the usual mode adopted, should be made to pass for some distance directly over a broad surface of running hot water, so as to give time (which is an important element) for the air to absorb sufficient water before reaching the ward.

In public buildings, where for a short time a large number of people are necessarily closely crowded together, such as churches, schools, theatres, legislative halls, on board steamships, and in all *badly-constructed hospitals* or other inhabited buildings, ventilation by the plenum method or the use of a fan is perhaps the most available plan; but we do not consider it the best method of ventilating one-story pavilion-hospitals when the wards are widely separated from each other and from all other buildings. If the plenum method is the best method, then why not build the pavilions with many stories, and only wide enough apart to admit sunlight, and keep the fan going winter and summer, having the fresh air brought from a distance?

We do not discard the use of fan-ventilation in one-story wards upon theoretical grounds, for we are aware that many scientific experimentalists have decided in favor of the plenum method of ventilation as compared with any other method; but, so far, practical experience in hospitals has shown that the one-story pavilion-hospital with the exhaustion method, or so-called natural ventilation, has given the best results in curing the sick, and has produced fewer cases of hospital-disease than any other.

We should be satisfied to alter our choice if by actual trial the fan-ventilation proved to be beneficial. But the success attained in one-story ward-pavilions

with open fires leaves little to be desired—not enough to warrant any effort toward a change by experimenting on a large number of wards; nor is a change desirable, except in so far as economy is concerned.

Warming.—Heating may be classed under two general heads:

1. By direct radiation; that is, by rays of heat emanating directly from the incandescent body in which chemical changes are producing heat. The open fire is the type and the only method now in use. Charcoal-braziers are rarely used since chemistry has demonstrated the danger from the gases given off by combustion.

2. By indirect radiation; that is, by the heat being transmitted first to some intermediate body and thence to the air and bodies in the ward. The closed stove, coils heated by steam or hot water circulating in them, and hot-air furnaces, are the usual methods adopted.

The direct radiation, or open fireplace, is a much more cheerful and in every way more agreeable method of heating to most persons, except for the accompanying dust which it is difficult entirely to avoid. The open fire does not seem to materially change or injure the normal constituents of the air.

The hot-air furnace is the least desirable method. It has all the bad qualities of the stove, without the advantage of the slight ventilating draught of the stove, while, being out of sight, a hot-air furnace not only continually bakes the dust, etc., in the air and deprives the volume of air of its normal amount of air-moisture, but it is also liable to become red hot, and poison the air with carbonic oxide which passes through red-hot iron

as readily as through a sieve. A poorly-constructed or badly-managed stove is as objectionable as a furnace.

Steam-heat at low pressure is not so bad as the above, but is not so agreeable or desirable as the heat from hot-water coils. Coils of hot-water pipes can be kept at a very low temperature, and, by using a large number, the air can be heated to an agreeable warmth and without materially injuring it, the air passing slowly and in a large stream over the coils before it enters the room. But, to produce this very desirable effect, on account of the large amount of pipe required, it is a more expensive method than open fires. Still, by having the water below 200° Fahr., as coils are more easily managed than open fires, they are very useful as an auxiliary or supplement to open fires in heating and ventilating a hospital-ward. The Chinese warm their houses by means of furnaces which heat the floor and walls of the apartment, the hot-air chambers being beneath the floor and between the walls. In the best houses the air is not allowed to pass directly from the hot-air chambers into the room, but must transmit its heat through the medium of the solid walls. If heating is the only object aimed at, such a method is very economical, and the warmth is evenly distributed; but it would be next to impossible to secure walls so perfect that they would prevent entirely the passage of the gases of combustion from entering the room. Besides, the advantage of porous walls would be lost, and ventilation would be difficult.

Open fires have this very great advantage over any other method of heating a hospital-ward, that at the same time they heat they prove to be powerful ventilators.

We give below what we consider one of the best methods of ventilating and heating a one-story ward such as we have described as being thirty feet wide by one hundred feet long.

Ward Heating and Ventilation.—In each ward there should be *two* main heating and ventilating shafts placed at a distance of twenty-five feet from either end on the long axis of the ward. They should be circular columns of masonry about three and a half feet in diameter, passing up from the basement through the ward and above the roof. In these shafts there should be two open fireplaces or open soapstone stoves with their backs to each other and facing the line of the short axis of the ward. From the outside a duct for fresh air, with a *high lead* so as to get pure air and avoid surface or ground air, should lead to a hot-air chamber behind each fireplace, which should have an exit for the *warmed air* into the ward about three and a half feet from the floor.¹ This exit should be covered and regulated by a register on the sides of the ventilating shaft facing the side-walls of the ward. The four fireplaces would usually be sufficient to heat the ward, but, as an auxiliary in severe weather, there should be boxes of hot-water coils between the walls in each of the four corners of the ward, which would connect with a fresh-air duct from the outside, and have warm-air registers opening in the ward near the floor. These hot-water coils could be placed just below the floor, in boxes well protected from the cold, having valves in *their fresh-air ducts*, with handles in the ward, so as to easily regulate

¹ These hot-air chambers should be so constructed as not to overheat or bake the incoming fresh air.

the amount of cold air admitted. The hot-water pipes could run between the floor or in well-protected boxes just beneath the floors.

Ward Ventilation.—During the winter the four open fireplaces should be the principal ventilators. The means of admitting fresh air should be the ducts connected with the hot-air chambers behind the fireplaces, and the boxes of hot-water coils, the small sash on hinges at the top of the windows; and, besides, there should be three fresh-air ducts, one in the centre of the ward, and the other two between either chimney or ventilating shaft and the ends of the wards. These fresh-air ducts should be about twelve inches in diameter, extending directly through the ridge of the roof to a short distance above the roof, where they are protected by a cap, and where the fresh air enters them. At this end there should be a cover or valve that could be worked from the ward to cut off the draught at pleasure.

These ducts, made of thick wood, so that the air of the ward would not readily heat them, should project down into the ward until within seven and a half feet of the floor, where there should be an adjustable scatter-plate placed beneath the open end, to prevent the cold from falling in a mass and to divert any chance outward currents, and at the same time scatter the fresh air and direct it upward. We have thoroughly tested this method of admitting the fresh air by two such shafts in a hut with an open stove, and find that it admits cold fresh air into a heated room to better advantage than any method we have seen.

The objects aimed at in contriving these air-ducts were—1. To introduce cold fresh air and avoid

draughts; 2. To introduce the heavy cold air in such a way that in falling to the floor it would assist ventilation by driving the foul air *downward* and outward. This method of introducing the cold air forces the foul gases and effete and poisonous organic matter downward, which is the direction they naturally take when undisturbed by currents of some force in an upward direction. With every expiration a certain amount of carbonic-acid gas and effete organic matter is thrown off by the lungs. The carbonic-acid gas, being of a higher specific gravity than air, sinks to the floor. The organic matter, when first thrown off, is held in solution by the watery vapor of the breath. This watery vapor, coming in contact with cold air, condenses and carries with it, either in solution or in the form of solid particles, the organic matter to the floor. If the vapor does not condense, the water is taken up by the air and the organic matter set free in the form of solid particles, which soon fall to the floor. This and similar effete organic matter is what either produces or at least forms the nidus for disease-germs. Now, it is found by experiment that in the air of a closed chamber, where the atmosphere has been still for some time and is left undisturbed by currents, these germs will also settle, so that fresh meat, milk, or vegetables, will remain for days undisturbed by the process of decomposition or fermentation, which always indicates the presence of spores or bacteria, the product of these invisible germs.

From the above it is plain that a downward current would remove these poisonous gases and particles by the most direct route and in the direction they naturally tend to take when left to themselves, and it is equally obvious that agitation of the air and upward

currents cause them to float about and settle and adhere to the walls and remain longer in wards.

3. That while descending the air would be moderately warmed and thus avoid a cold stratum of air along the floor, which is likely to be the case in rooms heated by open fires, and is sure to be the case if the cold air is admitted at or near the floor or in the side-walls. The descending shaft is necessary, for any opening in a heated room that is in or near the ceiling will act as an exit for the heated air which always tends to ascend, unless the counter-suction is very powerful and the air of the room but slightly heated.

In connection with these fresh-air ducts—to perfect the process and prevent the fresh cold air as it leaves the ducts from being drawn toward and up the chimney in place of the foul air—there should be a number of openings in the floor about three feet from the walls and directly under the beds. These openings should lead into foul-air ducts which run between the floors and connect with a large foul-air shaft in the column of masonry surrounding the flues of the two fireplaces. The flues of the fires should be of thin iron so as to heat this large foul-air shaft and cause a powerful suction on the smaller foul-air ducts. In the trials that were made in the hut alluded to—a hut twenty feet square with two descending fresh-air ducts—there were, connected with the large shaft surrounding the stove-pipe, three foul-air ducts with openings under the beds. When a fire was lighted in the stove, shavings were drawn into the openings under the beds and were carried along up and out into the open air.

In the permanent wards with twenty or more beds there should be a foul-air duct opening under each bed.

These foul-air ducts should be about six inches in diameter, of cast-iron as perfect as the best gas-pipes, and so arranged that with a graded slope and by means of openings closed by screw-caps, near where they converge and enter the large foul-air shaft, they could be washed by pouring water in these openings and allowing it to pass out by a small tube which runs from the end under the bed through the outside wall. This small drain-pipe should also be closed by a screw-cap. Disinfecting water could be used when necessary. As the openings would be under the beds, they need not be covered by a register, but during the summer when not in use should be closed and cleaned regularly. These openings should be fully as large as the ducts.

Besides the means for the escape of the foul air up the chimney and out at the foul-air shafts, there should be several openings along the ridge of the roof, which could be opened or closed at pleasure, for the purpose of giving exit to the hot air in the upper part of the ward, whenever it is desirable.

During the spring months, when it is not cold enough for a fire nor warm enough to open windows wide, the hot-water coils could be used to give the desirable warmth. For use at such a time, and even in the summer when with the windows open the air is heavy and still, there should be a special arrangement for creating a draught without heating the air of the ward. At this time a fan-ventilator would be useful, and one of Desagulier's fan-ventilators invented in 1727, to be worked by hand, could be tried. A draught could be secured by means of a small furnace; or, rather, places for lighting fires in should be ar-

ranged beneath the ward in the base of the ventilating column. The draught from these fires should pass up through the large foul-air shafts, and thus cause suction on the foul-air ducts without heating the air of the ward.

To make a draught in summer, perhaps a better way would be to arrange a number of hot-water pipes in the corner space in the ward, behind the coil used in winter, so as to create a draught in a shaft directly in the corner with an air-space and the masonry intervening to prevent heating the air of the ward. Gas-jets in the same position could be used.

Lighting the Ward.—If gas is used, the pipe should enter the ward through the elbow-corridor from the service-room; and in all parts except just where it passes into the ward it should be exposed to view, and kept in perfect order. Three or four jets at intervals under the ridge of the roof would be sufficient. Each jet should be covered with a glass globe, the opening at the top of which should be continuous with a tube leading directly into the open air, thus at once removing the gases of combustion.

No water-pipes should be laid in the ward, and under no circumstances should any drainage-pipes be either under, in, or about the *ward-building*.

Ward-Furniture.—There should be a centre-table for use while wounds are being dressed, and for merely temporarily setting things down on; but usually there should be nothing on it. The necessary medicines, instruments, etc., used by the doctors, could be brought in on a rolling table during their visits and then removed.

This table should be a slab of thick glass on a simple polished iron frame and should have soft-rubber rollers.

By the side of each bed there should be a small table, merely a glass slab fixed on an iron frame, and a bent-wood chair with arms, and a wooden bottom curved to make it comfortable, but every part smooth, without holes, and kept polished. If softer material is desirable for certain cases, rubber, air or water cushions should be supplied, but no wool, hair, or other kinds of cushions, should be allowed in the ward.

The bedsteads should be of wrought-iron, nickel-plated, with the improved wire mattress, and when necessary horse-hair mattress cleaned and fumigated frequently; the *size* of the bed to be three feet wide by six and a half long and two and a half feet high, and without curtains. In moving the beds two bars with rubber rollers to slip on the feet should be used.

Every ward should have two screens in three folds, and so large that with the two a bed could be surrounded on three sides, yet giving room sufficient to handle the patient. The frames of these screens should also be of wrought-iron and nickel-plated, and covered with white linen tied on, so that it could be removed and a fresh cover put on, at least once a week. Nothing more is needed as furniture in the ward.

All *urinals*, *bed-pans*, *spit-cups*, etc., should be of *glass*, instead of porcelain; for the least crack or shale in porcelain or imperfection of the glazing will allow organic matters to be absorbed and thus make them poisonous.

It would be better to supply each patient with slippers having rubber heel-tips to wear in the ward, if the floors are slippery, than to use carpets.

Attached to the wards there should be a hand-carriage, on wheels covered with rubber, for conveying the patients about, and a bath-tub on rollers of rubber.

Heating and ventilating the Service-Room Building.—Instead of the usual methods of having the heating apparatus in one central building, or a general boiler-house from which all the pavilions receive their supply of steam or hot water, it is preferable, on account of the wide separation of the pavilions, that there should be a small boiler in the basement of each service-room building which would supply the ward-coils with hot water, and also heat the service-room building, the elbow-corridor, and a certain proportion of the main connecting corridor if necessary. As the main corridor is cut off from all the buildings by doors, if well-arranged tramway-cars are supplied for carrying the patients, and others for conveying the food, it would not be essential to heat the corridors; they may be merely closed passage-ways, or, what would be better, a simple covered way protected by sashes on the north side in winter.

The ventilation of the service-rooms should be as carefully attended to as that of the ward. A foul-air shaft should be arranged around the flue of the furnace, and foul-air ducts similar to those in the ward should open into the different rooms, especially the water-closets; and, if considered desirable, downward ventilation for each closet could be arranged.

The small ward for special cases should have connected with the open fire in it a foul-air shaft and have a foul-air duct under each of the two beds; also a fresh-air duct coming in from under the eaves till it reaches

the centre of the room, then turning at right angles and descending to within seven feet of the floor, having a scatter-plate, etc.

The stairway from the basement in the northeast corner should be thoroughly ventilated, and cut off from the hall by a lobby.

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CHAPTER VI.

PAY-PATIENTS IN CHARITABLE INSTITUTIONS.

As we have said before, we believe hospitals as charitable institutions should be limited to the sick poor without homes; that every effort should be made to improve the condition of the homes of the poor, and to teach the poor to avoid sickness. Now, it seems to us that it would be a move in the wrong direction to offer an inducement to the sick, either poor or rich, to leave their homes and enter a hospital to be treated, especially if the hospital is called a charitable institution.

Independence and charity are incompatible. If the pay-patients do not receive greater care and attention and better food, there will be a strong temptation for them to claim to be subjects for charity, so as to save their money. We have seen this tested in one of our large pauper-hospitals: as soon as the patients in the pay-wards learned that they were no better off than those in the free wards, they would almost without exception, by failing to pay after the first installment, claiming to be too poor to afford it, endeavor to get into the free wards. After a short time the pay-ward was abandoned as a failure; and, so far as we know, the

plan of having pay-patients in the general wards of any of our charitable hospitals is practically a failure, and is maintained more for the purpose of keeping out undesirable cases than for the income derived from those willing to pay. The private-room plan succeeds better, but a private room cannot be kept up in a public hospital at less expense than in a private house or private hospital, for the doctors are the only unpaid officials, and, unless the pay-patient is made to pay for the doctor's service, the private rooms will not materially add to the income of the hospital.

If the attending physicians and surgeons of all our charitable institutions would refuse to attend pay-patients in these institutions, private self-supporting hospitals, entirely independent of charity, and free from the stigma of pauperism, would soon arise in sufficient number to supply all persons able and willing to pay for hospital treatment. Such a step would be not only best for the whole community, on account of its doing away with a custom that tends to increase pauperism, but would be at the same time an act of justice toward their professional brethren who are not so fortunate as to hold a position on the medical staff of a hospital. The above remarks are equally as applicable to dispensaries for out-door patients as they are to hospitals for in-door patients. The free and the pay dispensaries should be separate and distinct institutions, the free being based upon charity and strictly limited to the needy, the pay being based upon utility and being self-supporting institutions, as independent of charity and as free from all connection with pauperism as a life-insurance company or any other private corporation. A "provident dispensary" claiming to be a charitable

institution will supply a more enticing stepping-stone to pauperism than is now so unguardedly offered by our badly-managed free out-door dispensaries. But, if a well-regulated system of pay-dispensaries organized as independent, self-supporting institutions could be made to supplant the many free charity dispensaries at present existing on the plan of "free soup-houses," medicine being given instead of soup, we believe much good would be done.

At present the custom is, to offer hospital accommodations to any who are willing to pay for the care and attention, and to ask the medical profession to attend such persons without remuneration. This custom is in principle an injustice, but practically, as yet, the number of pay-patients in public hospitals has not been large. Such persons are charged a small sum if poor, and put in the wards with the other patients, or charged a high price if rich, and given a private room. Patients in private rooms should be allowed to select any physician on the medical board, and to pay him for his services, in addition to what they pay the hospital.

We will assume that thirty-two such rooms are needed, twenty for men and twelve for women.

Pay-Wards.—These wards, divided into two separate rows of rooms, should be constructed on the same principles as the other wards. They should be only one story high; and the service-rooms should be in a separate building, and connected by an elbow-corridor with the ward. The ward should be on a raised basement similar in every respect to the other wards, and should have its piazza at the south end. The ward should be thirty-two feet wide with a hall through the

centre eight feet wide, with rooms on either side twelve feet deep by fourteen wide, two of the rooms being sixteen by eighteen feet for two beds, as it is sometimes desirable to have an attendant or friend sleep in the room with the patient.

These rooms should be fifteen feet to the ceiling, with one window in the single and two in the double rooms, opening to the outer air; and, above the doors, opening on the hall, there should be a transom-window. The floors should be similar to those described in the other wards, and without carpets; rugs should be supplied if needed, but carefully attended to as to cleaning. The building should have a cap-roof the width of the hall, with sashes of glass between it and the main roof. Each room should have an open fireplace with foul-air shaft and ducts, and a fresh-air duct similar to that in the small ward described in connection with the service-room building of the other wards. Besides this, a curved tube or box could be made to pass out through the hall-wall and open into the outside air through a space between the cap and the main roof. The *outside walls* should be similar to those described for the permanent pavilions, but the partition-walls between the different rooms and between the hall and the rooms should be made as nearly as possible impermeable to air, for the air drawn into a room through these walls would not be fresh, and in some cases might be very bad. The accommodation in such a ward should be limited to eighteen beds. Therefore two detached pay-wards and two or more special huts would be needed.

The service-room building for a pay-ward should be separated in the same way and for the same reasons as in the other buildings. The first floor, that on a level

with the ward, should be divided by a hall with the water-closets and two bath-rooms on one side, and a comfortable dining-room with an open fireplace and a pantry communicating with the kitchen by dumb-waiter, and a room for the nurse in charge, on the other side.

If hot-water coils are needed, instead of having a boiler, hot water could be laid on from the administrative buildings, as the pay-wards should be not far removed from them. Hot water for the baths and for carrying to the rooms should be supplied by the kitchen-range. No pipes except gas-pipes, and these exposed to sight, should be laid on in the wards.

In the pay-ward, where the beds are in separate but adjoining rooms, with a common hall, no infectious or contagious cases should be treated, and no case liable to become infected or in any way dangerous to others should be admitted; for in such a building, although there are intervening walls, a case of the kind would be more dangerous than in a building without partitions. Not that the patient in the next room is not for a time in less danger of being poisoned than he would be if no wall intervened; but an infectious case, or one liable to cause infection, would be more likely to poison his own room, and thus do more permanent injury, than a similar case in an open ward.

For all infectious cases, and for treating all severe and dangerous cases among the pay-patients, there should be huts specially constructed for that purpose.

CHAPTER VII.

SPECIAL ISOLATED HUTS FOR CERTAIN IMPORTANT CASES,
SUCH AS OVARIOTOMY AND OTHERS EXTREMELY SENSITIVE TO INFECTIOUS MATTER.

It would be better if such cases were treated in every way separate from a hospital in which other diseases are treated; but a certain number of such cases must be admitted to hospitals, and, unless special institutions exist for the sole purpose of caring for them, they must be provided for in connection with general hospitals.

We will give the plan of a hut with special reference to patients operated on for ovarian tumors.

Ovariectomy is one of the most formidable of all operations in surgery, and while the operation is going on the largest serous membrane in the body is exposed to the air. This membrane, the surface of which is many times as great as the largest stump of an amputated limb, is remarkable for its *great susceptibility to absorb septic poisons*. When once inflammation sets in, the great majority of cases prove fatal. In fact, a patient after an operation for an ovarian tumor is the per-

fect type of a surgical case that is exquisitely sensitive to septic influences. When once infected, on account of the large surface and position of the membrane involved, it seldom fails to generate and give off sufficient poison to infect a building; and, like a case of puerperal fever, it renders the apartment, if not forever, at least for weeks and months, unfit and dangerous for the treatment of other cases.

On account of this extreme susceptibility to contract septic diseases, and the harm such a case does to the building, it is a direct violation of a sanitary law, and a risk not only for the individual patient, but to all other surgical cases treated in the building, for a case of ovariectomy to be treated either in the ward of a hospital, or in a room near the ward, particularly if that room is but a few steps from the water-closets and bath-room. No nurse, doctor, or other attendant, who has the care of other cases, especially other surgical cases, should be allowed to have charge of, handle, or come near, a patient operated on for an ovarian tumor.

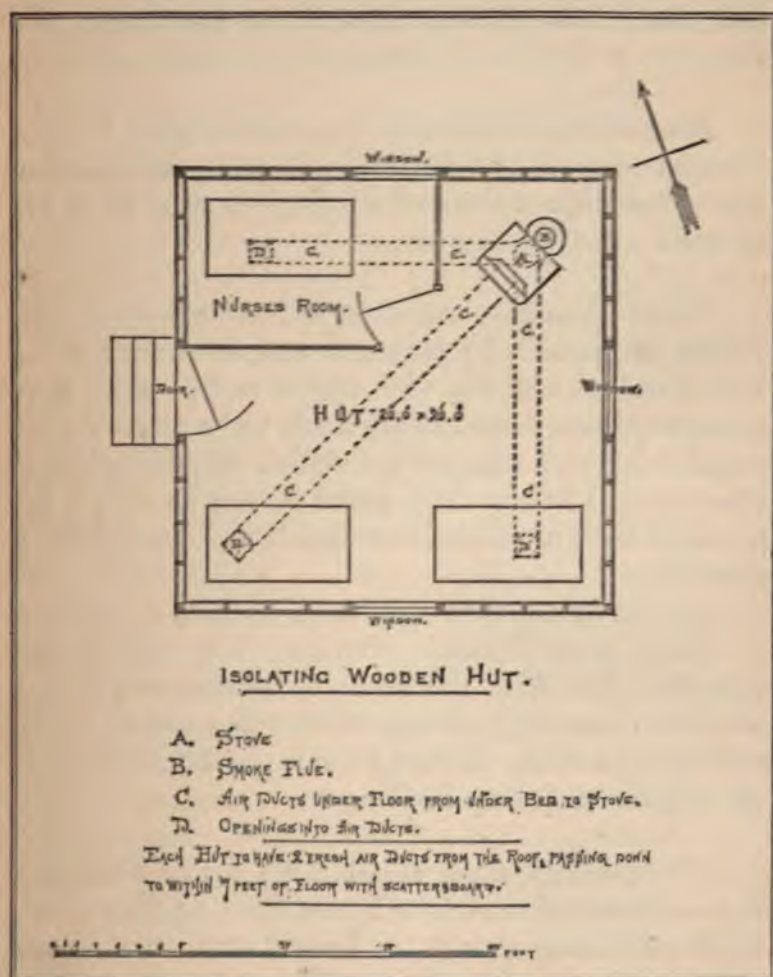
Patients operated on for ovarian tumors should be treated in small one-story huts, which should contain at most not more than two beds, one for the patient, the other to be used by the nurse or attendant during convalescence when the critical stage is past.

The building should be small, not only because such a building is easily ventilated, but, if it were to become infected, it could be destroyed, and a new one erected at a small expense.

There should be two or more huts, so that they could be used alternately and, when not in use, be left open to the sun and air for purification.

THE PLAN OF THE HUT.

Ground.—The ground should be covered with a layer of concrete, and asphalted beneath and for several



feet around the building, and surrounded by an open shallow gutter as a drain.

Position.—As the building is square, its position should be about north-northeast, that is, the side toward the north should be about perpendicular to a line running north-northeast. In this position the rays of the sun would reach all four sides of the hut during the day.

Dimensions.—The drawing represents a hut twenty feet square, eight feet high to the eaves, and fourteen feet to the ridge of the roof, which gives $20 \times 20 \times 11$, or 4,400 cubic feet of space.

Floor.—The floor should be of the *heart* of Georgia yellow pine, which by nature is well filled with resin, and should be well laid with tongue and groove. Carpenters are accustomed to lay floors to be covered with carpets, and, as a rule, are not skilled in putting down closely-joined floors. The beams should be sealed beneath, so as to make the floor double and protect from the cold.

Height from Ground.—The floor should not be less than two feet from the ground. During very severe weather, if necessary, the space beneath could be closed with glass sashes. Locust posts make the best underpinning for temporary buildings.

Walls.—Brick walls would make a more substantial and for some reasons a better building than wood. If of wood, they should be double, with an air-space of several inches between them, so arranged as to be opened at pleasure both at the top and bottom on the outside of the building, but not from the inside. This

would be of importance in summer. The inside wall should be closely joined, and planed and painted, or polished. If the wall is of brick, an air-space should be left in the centre, so arranged as to communicate with the space between the roof and ceiling, and to allow of easy ventilation and fumigation of all these spaces.

The Roof.—The roof should be double, with an air-space of several inches clear intervening—not so much to keep out the cold as to prevent overheating in summer. This space should also be made so as to be either closed or opened from the outside. The roof should extend far enough beyond the walls to protect them from the weather, especially at the gable-ends.

The Windows.—The end-window facing the east, and opposite the door, should extend from within two feet of the floor and run up as high as the roof will admit; or there should be a small window above the large one arranged on hinges so as to open at the top. Besides this there should be an opening through the end-walls just under the ridge, covered by a register, to be closed or opened at pleasure. The two side-windows, commencing about the same distance from the floor, would necessarily be not more than six feet high. Above the door there should be a small window on hinges similar to the one above the end-window. All the windows should be not less than three feet wide; the large end-window might be four feet wide, so as to give a good light for the operations. It would perhaps be better to have a northern light, but the great majority of operations are done in the afternoons, so that a window facing east would answer every purpose. The

sashes should be balanced with pulleys, and be of very thick plate-glass or double glazed, not double sashed. In a temporary building everything must be inexpensive, but the glass of the windows could be used indefinitely, and on that account it would not be bad economy to have thick plate-glass. The wood-work should be plain and smooth, and kept waxed and polished.

The Door.—There should be but one door, three and a half by seven feet, in the end facing west. It should be wide enough to admit a patient carried on an ordinary stretcher. The door should be perfectly plain and without panels. During severe weather the entrance should be protected by a closed framework with a door opening southward.

Huts for ovariectomy cases should not have a nurse's room, but in huts for chronic suppurating wounds, etc., the nurse's room should be in the northwest corner, eight by twelve feet, the long axis lying east and west so as to include one of the side-windows. It should be separated from the ward by a partition, which should not be more than seven feet high, with a space of about one foot left open between it and the floor, so as to allow a free circulation of air, and room for cleansing, etc. This partition or screen should be perfectly plain and smooth, without cracks and corners, and so put up that it could be readily removed without disturbing the building in any way. It should have a door three by six and a half feet in the free corner.

Heating.—In a temporary building of this kind the expense would be too great to build a chimney and

have an open fire; therefore a Franklin soapstone stove, or some kind of iron stove surrounded by a protector, must be used, being preferable to steam-heat, even if it were possible to introduce it from other buildings. The position of the stove should be in the northeast corner, so that the force of the cold northeast winds driving through the wall would carry the heated air to the bed of the patient on the south side of the room. By means of a special flue surrounding and heated by the stove-pipe, the foul air of the ward should be drawn off. A ten or twelve inch pipe inclosing the ordinary six-inch stove-pipe would make an excellent foul-air shaft. In so small a building a stove will heat it satisfactorily in cold weather, and, unless the hut is double roofed, the heat of summer will give more trouble. The stove should be an open one, of a rather large size, and in very cold climates the stove-pipe should not pass directly into the foul-air shaft, but ascend some distance before entering the shaft, thus giving off more heat in the ward.

Lighting.—The lighting must be either by a gas-jet, or a lamp suspended near the centre; the latter would be less expensive. In either case the consumed air from the light should be conveyed by means of a special shaft or flue directly through the roof into the open air; otherwise, while burning, an ordinary gas-jet will consume more oxygen and give off more carbonic-acid gas into the ward than seven patients; whereas, if its heated air is conveyed off by a tube to the open air, it will assist materially in ventilating the room. Candles, and not hand-lamps, should be used to supplement this central light.

Ventilation.—During the weather not cold enough to require a fire, the building can be readily ventilated by the windows; but, when the weather necessitates closing the windows, other means should be and can be easily arranged for drawing off the foul air. In each corner of the floor of the room, three feet from the walls, there should be an opening communicating with a duct between the floors which leads to the foul-air shaft of the stove; or, if there is no special flue or shaft in connection with the stove, and separate from its own flue, it would be a simple matter to so arrange it that the stove would draw all of its draught from these ducts. The ducts for the huts for ovariectomy cases should be cast-iron pipes similar to those described for the wards. In the huts for infectious cases they could be made of boards eight or twelve inches wide, or of tin pipes covered with straw packing to protect from the cold in case only one floor is laid. The opening in the floor should be not less than ten or twelve inches square, and protected by a grating, and so arranged as to catch dust, etc., in a dust-box, which could be opened from beneath, and, if desirable, left open during the summer; yet, when malaria prevails, all fresh air should be admitted as high from the surface of the ground as possible.

Now, much of the air would come in from the outside through unavoidable crevices and directly through the boards; but this would not be sufficient; and, instead of letting the air in by the windows, it would be better to convey the cold air as near the centre of the room as possible before allowing it to scatter. To accomplish this, a very simple means would be, to have two

large shafts or tubes¹ pass through the ridge, projecting above, and opening into the air on the outside and protected by a cap; on the inside they should come down to the level of the top of the side-walls, that is, seven or eight feet from the floor, where they should be arranged so as to be opened or shut at pleasure, but high enough to be out of the reach of the patients; and just beneath the openings there should be a scatter-plate so fixed as to cause the cold air descending to flare and scatter through the room and thus prevent draughts of cold air. A large, ordinary tin basin with flaring edges swung beneath the end of the shaft would answer as a scatter-plate. The shafts should be twelve by twelve inches in diameter, or, if it is better to have them flat so as to pass more readily through the roof, they should be six by twenty-four inches and should pass through the ridge on either side three feet from the centre of the roof. If thought desirable, two similar shafts can be passed through the ridge with no projections down into the ward, but opening near the roof for the purpose of carrying off the overheated air; by means, however, of the two high openings in either gable all overheated air could easily be got rid of.

FURNITURE.

Beds.—The beds should be of cast-iron, nickel-plated, and a little wider than the usual hospital-bed. The mattresses should be of hair, and they should be often washed and disinfected, and the next patient should have a fresh mattress. If wire mattresses equally good can be had, they would be better

¹ An account of which has already been given in describing the fresh-air ducts of the wards.

than hair. Hair pillows, treated in the same way, should be used. The blankets should be changed as often as the sheets: they are just the things to catch organic particles, and retain them till decomposition takes place, and thus poison the wound.

Tables.—A table with a glass top, five by two and a half feet, should be in the ward, as it would be needed for operations. There should also be a small stand of iron for the basins and water-vessels. Water-pipes should not be laid on in the building; the drains would cause more danger than the convenience would compensate for.

Chairs.—The chairs should be plain, with wooden bottoms. If a patient, while convalescing, should require an easy-chair, it should be brought in for the occasion. No cushion or anything of the kind should be allowed to remain in the room.

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CHAPTER VIII.

ADMINISTRATIVE BUILDINGS AND ARRANGEMENT OF THE BUILDINGS ON THE GROUNDS.

Separation of the Ward-Pavilions.—Miss Nightingale laid down the rule that “the distance between the blocks (the pavilions) should not be less than double the height of the block.” This has been very generally accepted. We do not think this allows sufficient space. The distance between the pavilions should not be less than *three* times the height of the buildings.

In the ward-pavilions that we have described, measuring from the floor of the ward to the ridge of the roof, the height is about twenty-four feet. Three times this would be seventy-two feet, which we consider should be the minimum of space left between each ward and all other buildings, excepting its service-room building. If the ground-space is sufficient, we would have the distance between the wards one hundred feet. If tramway-carriages are used, the increased distance, as it is on a level, would not make an appreciable difference.

The isolating huts for special cases should also be

widely separated from each other and all other buildings. The huts and tents for infectious cases should be widely separated and placed on the grounds in a position where they would be least likely to infect any other buildings.

Position of the Ward-Pavilions.—The wards, with their long axes lying north and south, should be arranged on the southern exposure of the grounds, not only to get the sunlight, but, in our climate, during the summer months, when the windows are open to receive the full force of the prevailing winds.

On one side of the grounds should be placed the wards for men, on the other the wards for women and children. The pay-wards should be placed on either side of the administrative building, but well separated from it and all other buildings.

The Administrative Buildings.—These should be separate from the wards, and placed on that part of the ground where they would not intercept the prevailing summer winds. The northern side of the grounds would be the best position for them in our American climate. The administrative or executive building should occupy a central position on the northern side, and have the kitchen, store-rooms, the operating-theatre, drug-room, etc., arranged around it and connecting with the main corridor from the wards.

The executive building should have the reception-offices, the managers' room, the medical-board room, and the superintendent's office, on the first floor. On the second floor there should be rooms for the members of the house-staff; above these should be rooms for the

male attendants. The basements could be used for certain stores.

The general kitchen should be placed in the rear of the executive building, convenient to the main corridor. The kitchen should be supplied with all the latest improvements in cooking-apparatus, and should have special arrangements to prevent the flavors of all the different articles cooked from mixing. There should be a special diet-kitchen distinct from the general kitchen, and under a different management. Connected with the kitchen there should be well-arranged store-rooms for vegetables, meats, etc.

Bath-House.—The general and medicated baths should be convenient to the main corridor and near enough to the kitchen to use the same boiler-house.

The Apothecary-Shop.—The drugs for the wards should be in a small building convenient to the corridor and to the operating-theatre.

Operating-Theatre.—The operating-theatre should be in a separate building as well ventilated, and kept as scrupulously clean, as the wards. It should have an operating-table surrounded by raised seats, with an etherizing-room and a recovery-room convenient. The operating-room should have a good *northern* light. In no case should the operating-theatre be in the same building or even near either the pathological rooms or the dispensary for out-door patients.

If the wounds are poisoned by the foul air of an operating-theatre during an operation, the best-constructed wards cannot save the patients. One who

is familiar with either pathological rooms or the steaming stench of a crowded dispensary where all sorts of people with all kinds of disease are assembled will readily appreciate the danger of having an operating-theatre in or near the same building. The number of seats in an operating-theatre should be limited to the number from which an operation could be closely observed. It is useless to have a class of several hundred students present at an operation; it is not possible for them to see it to any advantage.

Accident-Ward.—Convenient to the ambulance-drive and to the office, and near the operating-theatre, there should be a small accident-ward, where severe cases could be detained to receive immediate treatment, and where, if in a dying condition, they should remain instead of being removed to a ward to die in a few hours and create a disturbance.

The Stable.—The stable for the ambulance-wagons and horses should be on the outside near the northeast or northwest corner of the grounds, and should have telegraphic communication with the offices in the executive building. The necessary workshops for the hospital should be in the same position.

The Autopsy and Pathological Building.—The *post-mortem* and pathological building should be in either the northeast or northwest corner of the grounds, and cut off from the rest of the grounds by a high wall and intervening trees and shrubs. The attendants should in every way be separate from those of the wards.

The doctors in the hospital, or those who visit the wards, should never be allowed to make a *post-mortem* examination, or even be present when one is made on an infectious case. There is always danger of infection being conveyed to the wards from a *post-mortem* building, and this cannot be too carefully guarded against.

The Out-Door Dispensary.—The dispensary-building should be adjoining the grounds of the pathological building, and should have a separate entrance from that of the hospital, with its own attendants distinct, both medical and otherwise, from those of the hospital. If it is in or near the executive building, the number of persons passing in and out will create confusion, and render discipline in the hospital more difficult, besides being a constant source of filth and dirt, and of infectious and contagious diseases.

The buildings for the training-school and home of the nurses should be in one of the corners of the grounds nearest the executive building.

The Laundry.—If convenient arrangements could be made, it would be better to have the laundry entirely removed from the hospital-grounds, on account of the immense quantities of foul fumes necessarily generated and given off from a large laundry. If it is on the grounds, it should be on the outside, near the corner on which the training-school building is situated.

The laundry should be divided into not less than two parts, one for washing ordinary soiled clothes, the other for badly-soiled clothes. There should also be a well-arranged hot-air chamber for disinfecting purposes, and a mending-room, near the laundry.

As far as possible, the clothes should all be dried *out-of-doors* in the *open air* and *sunlight*. Linen dried in closed rooms not only is not purified by the open air and sunlight, but in such a room one piece of linen not well washed and containing foul matter would taint all the others, and after such a room has been used for some time it necessarily becomes foul, and liable to infect anything that is dried in it. In connection with the laundry there should be a drying-yard, a part of which could be covered with a roof of glass for use in bad weather.

The foul linen should be brought twice a day from the wards, each ward having two large nickel-plated metal vessels with close-fitting lids: one vessel for ordinary linen, the other for badly-soiled linen. These vessels should be regularly cleansed and disinfected every day, and the one for the foul linen should always have a disinfecting fluid in it. Such a thing as a "foul-linen shoot" should never exist either about a hospital or anywhere else. We have known, we are sorry to say, of such "shoots" made of rough bricks and plaster, without any lining, being used in a hospital.

The Water-Supply.—There should be an abundant supply of water for the use of the hospital, and a reservoir for a reserve-supply in case of an accident to the usual source. The water-pipes should be made to connect with each service-room building of the pavilions, and could be laid along the line of the corridors, but in no place should they be laid near the sewer or drainage pipes.

Sewers and Drainage-Pipes.—If practicable, the hospital should have its own sewer-main leading direct-

ly to the body of water in which the sewage of the city empties; it should be made as nearly as possible of impermeable material and well ventilated, and so arranged as to prevent a rising tide from forcing back the foul gases into the drain-pipes. On the hospital-grounds the pipes should be impermeable to air, and guarded with traps. Each drain-pipe should have its own trap, and each pavilion should have a large trap where its main drain enters the sewer. The sewers should not run under any building, or near a ward, or near any of the water-pipes.

The drain-pipes from the closets, sinks, etc., should not only be carefully guarded with traps, but should be so constructed as to be easily and completely examined without tearing up any part of the building.

Special arrangements should be made to simultaneously flush every drain-pipe and sewer on the hospital-grounds once every twenty-four hours.

Cultivation of the Grounds.—There should be a good supply of foliage on the grounds, not merely for ornament or simply for shade, but for its purifying influence on the atmosphere. Between the wards there should be grass-plots, with shrubs and flower-beds in them. All space not covered with grass or flowers should be asphalted.

In the space between the administrative buildings and the wards, and between the different sets of wards, there should be trees placed where they could not intercept the sunlight from the wards, nor in any position where they would to any great extent interrupt the free circulation of air over the grounds. The trees should be carefully selected with regard to their foliage, which

should be of a nature not to make it difficult to keep the grounds free from decaying vegetable matter. All the grounds should be carefully kept in order by a skillful gardener.

The pathological and *post-mortem* building, the stables, and the laundry, should be cut off from the rest of the grounds by dense hedges.

CHAPTER IX.

RELATIONS OF THE MEDICAL SCHOOL AND THE TRAINING-SCHOOL FOR NURSES TO THE HOSPITAL.

THE MEDICAL SCHOOL.

LET us suppose the school to be conducted somewhat after the following plan :

Requirements for entering the Medical School.—A good English education ; a good knowledge of mathematics ; a good knowledge of Latin ; a good knowledge of physics, especially chemical physics.

After Admission.—First Course: This course includes practical chemistry, biology, including botany, anatomy, a part of physiology, and the use of the microscope. To consist of work in laboratories and didactic lectures to be given in the college buildings entirely separated from the hospital-grounds. Time allowed, two years ; but every year there should be a rigid examination. Those passing this examination satisfactorily should be advanced to the second course.

Second Course: The second course will include special study of human anatomy, in the dissecting-room ; physiology and pathology, in laboratories ; practical pharmacy, hygiene, and sanitary subjects ; and, during

the second year of this course, clinical lectures and instruction as far as can be given in connection with out-door patients of the dispensary. During this course, all lectures and instructions should be given in the medical school and dispensary buildings, and not in the hospital proper. Time of course, two years. But, as in the first course, more stress should be laid upon the ability to pass the examination for the third and final course than on the time of study.

Third Course: This course will include special study of therapeutics and clinical medicine and surgery. Most of the lecture instructions of this course should be given in the amphitheatre and wards of the hospital.

If the pathological, autopsy, and other school buildings, together with the dispensary for the out-door patients, are placed in one corner of the grounds, and separated by a high wall from the rest of the buildings, and the students be divided into classes somewhat after the plan just given, the relations of the medical school with the hospital would, we think, be much simplified and made more satisfactory than by the arrangements usually adopted.

Only the advanced students of the third or graduating class would have access to the operating-amphitheatre and the wards of the hospital. Thus, instead of a class of several hundred students of all grades, creating a disturbance around the hospital, and cramming to its utmost the amphitheatre to witness an operation which they do not understand—and which, if they were capable of appreciating, on account of the crowd, they would be unable to see or gain any practical advantage from—there would be, if the requirements for attaining the third class were such as they

should be, not more than from thirty to fifty students present at the operations and clinical lectures in the amphitheatre of the hospital, and those present would not only appreciate but see to advantage all that takes place.

By means of a special competitive examination open to the students who had reached the second year of the third course, *internes* or house-staff could be selected: say, that to every two wards, one medical, the other surgical, a student would be appointed to serve six months as junior, six months as senior, and six months as house physician or surgeon. This would diminish the third class by sixteen or twenty every year, and those failing to obtain the position of *interne* could during the last year of the third course be instructed by the professors or attending physicians and surgeons in the wards of the hospital.

The professors of the first course would have no connection with the hospital. The professors and the class of the second course would have no connection with the wards of the hospital, thus avoiding a great source of infection, namely, that caused by the medical and other attendants of the *post-mortem* and pathological departments, who would carry infection into the wards on their hands and in their hair and clothes. The professors of the third course should be the attending physicians and surgeons to the hospital, and constitute the medical board. In the hospital affairs they should be as a board second in authority to the trustees alone.

The adoption of such a system as has been outlined would not only serve the best interests of the students, but those of the patients also. It would give the students the special advantage of clinical instruction in

a much more satisfactory manner than is at present afforded in this country, and it would do away with one of the worst features of medical schools abroad, namely, where they take possession of a hospital, permitting students of all grades to follow the attending physicians and surgeons in their visits to the wards, and under the name of dressers to assist in caring for the sick.

We do not consider the interests of the patients and those of the student at all conflicting. On the contrary, we think that a hospital, so far as the interests of the patients are concerned, is very much improved by having a medical school attached.

The very presence of the school insures a better and higher class of attending physicians and surgeons than could be otherwise obtained. The presence of the students stimulates the professor to give his time and close attention to each patient; and the ability of the house-staff causes him to be careful not to make mistakes. His acts are public, and subjected to severe criticism.

To make the hospital complete for the interests of the medical school and of the training-school for nurses, there should be a lying-in department, but the best authorities are decidedly opposed to maternity-wards being connected with a general hospital. A case of puerperal fever is perhaps the most infectious and dangerous case possible, not alone to other lying-in women, but to all patients with open surgical wounds; and there is no question but that the proximity of surgical wards is sure to cause puerperal fever in lying-in wards.

It would be very desirable to have a maternity-hospital established on some other building-spot as remote

from the general hospital as convenience will allow. We do not favor large lying-in hospitals. Experience teaches that any kind of a home is a safer place for a woman to be delivered in than any hospital, but there are a certain number of cases that have no homes and must be provided for. All the lying-in wards should be small, containing not more than from two to six beds, and the wards should be in detached, one-story cottages.

If there is no special building for the treatment of the eye and ear, the oculist should have a room or apartments well arranged with all the necessary apparatus, and a certain number of beds assigned him, for the treatment of eye and ear cases.

RECEPTION-HOSPITALS, AND SYSTEM OF AMBULANCES TO SUPPLY THE HOSPITAL WITH PATIENTS AND INCREASE ITS USEFULNESS.

It would be very desirable to have two or more small reception-hospitals established in the city for the immediate reception of accident and other cases of emergency before being removed to the general hospital.

These reception-hospitals should contain not more than from four to six beds. They should be distributed in different parts of the city where they are most likely to be needed. A surgeon (young men who have had hospital experience would be the best suited for the position) should be in charge with a nurse and an orderly under him.

Each reception-hospital should be connected by telegraph with the police-stations in its district and with the general hospital, and each should be supplied with

an ambulance, which should be always in readiness to start for the scene of an accident, with all the apparatus needed to care for accident-cases until they could be transported to either the general hospital or the reception-hospital.

These reception-hospitals serving as feeders to the general hospital, would add much to its usefulness and keep it supplied with the most desirable cases for the purpose of clinical instruction.

The interest of the municipal officers might be enlisted in the establishment of this system of small reception-hospitals and ambulances, and perhaps they might be induced to carry them on in connection with some public department of the city; as, for instance, in connection with the police department, a part of the police-stations being used for the hospital. The plan would not be an expensive one.

THE TRAINING-SCHOOL FOR NURSES.

The building for the training-school should be in the northwest corner of the grounds. It should be arranged as the home for nurses, where they should take their meals and sleep.

Allowing one nurse to every six patients for a hospital of four hundred beds, there should be about sixty nurses and student-nurses or pupils. To accommodate each of these with a separate room ten by fifteen feet in size, the building should be forty feet wide by one hundred and fifty feet long and three stories high. On the first floor there should be the apartments of the superintendent of nurses, a reception-room, dining-room, and a school or lecture room. On the upper floors should be the dormitories for the nurses, each nurse having

her own room. The kitchen, baths, and water-closets for this building should be separated from and connected with the building by a short corridor, in the same manner as has already been described in the plan for the ward for pay-patients. The dormitories and halls should be constructed and ventilated in the same way as in the wards for pay-patients.

There should be a lady superintendent of nurses; under her, a general housekeeper, a woman to have charge of the linen and laundry, and one to have charge of the special diet-kitchen and special diet-list.

To each ward of twenty-four beds there should be a head-nurse, and under her control as assistants there should be a night-nurse and two or three probationers or student-nurses, and, when needed, a special night-nurse. The head-nurses on the male side should have besides the above, under their control, an orderly or man assistant.

The lady superintendent should have full control over all the nurses, should assign their duties, etc., but she and all of the above-mentioned assistants should be under the control of the resident superintendent of the hospital.

Besides the above organization, in no way interfering, but working in unison with it, there should be a school board of instructors whose duty it would be to give lectures and special didactic instructions to the student-nurses during their pupilage, and to act as an examining board of nurses.

There should be at least one instructor, a physician, to teach the nurses what they should know about medical cases and the administration of medicines; one to teach them what they should know about surgical

cases ; one to give instructions on hygiene and sanitary subjects, and a skilled woman to teach the cooking of special diet.

These instructors, with the lady superintendent and one other lady—from a committee of ladies whom the trustees of the hospital should elect to inspect the school and keep watch of the nurses after graduating and to see to the general interests of the school outside of the hospital—should constitute the Faculty of the Training-School for Nurses.

It would be necessary for the instructors to prepare suitable text-books for the nurses, as there are no good ones in existence.

The students and assistant nurses can be spared from the wards in the afternoons and evenings, long enough to give sufficient time for study and recitations.

CHAPTER X.

IMPROVEMENT OF HOSPITALS NOW IN USE; SMALL HOSPITALS; LYING-IN HOSPITALS; HOSPITALS FOR CONVALESCENTS; ARMY HOSPITALS; INSANE-ASYLUMS.

THERE is no immediate prospect that any of the large hospitals now in use will be replaced by entirely new structures.

In the case of public hospitals under the control of the State or municipal authorities, nothing less than a political revolution brings about a change. The instances are rare in which the ravages of a fatal epidemic give outsiders a chance to force a change for the better. Hospitals founded by individuals or by bequests are, as a rule, spoiled in the beginning by the strong tendency to put up a magnificent monumental structure. So much money is usually sunk in these fine buildings that there is nothing left to pay for new buildings, and necessity compels a continuance of their use. In all such cases about the only proposal that is likely to meet with favor, so far as improving the construction of the hospital is concerned, is to have one or more detached wards for certain classes of cases erected on the grounds as far removed as possible from the old buildings. Very often there is no ground-space for

such wards, but it is rarely the case that room cannot be found to put up one or more isolating huts and thus provide a place for dangerous cases.

In some cities there are laws regulating the construction of, and the number of lodgers admitted into, the lodging-houses, thus preventing the evils of overcrowding. With the same end in view, it would be wise and just for the same authorities to enact a law, if not to regulate the construction of hospitals, at least to regulate the number of hospital inmates in accordance with not only the cubic air-space, but the general hygienic condition of the atmosphere. Thus managers would be compelled to improve the construction of their hospitals or make up for their defects by limiting the number of inmates in each ward. The more faulty the construction, the greater the cubic air-space which must be allowed each patient.

SMALL HOSPITALS.

Hospitals containing as many as four hundred beds must necessarily be comparatively few in number; and nearly all hospitals, like cities, must have small beginnings.

In this country the sick poor of small towns and country districts are usually sent to the poor-house of the county, and many of these almshouses have no special accommodations for the sick. Where the number of sick does not exceed ten or twelve, they could be provided for by the erection of four or five cottages of from two to six beds each, one or two being reserved for infectious cases. The plan already given for the isolating huts could be followed in building them.

In case the number of sick poor *compelled* to seek

treatment at the hands of the community exceeds thirty, it would be better to establish a hospital separate from the almshouse. A small administrative building and two wards of not more than from sixteen to twenty beds each—one for men, the other for women—supplemented by several isolating huts, would be all that would be required. In these small hospitals none of the principles laid down for the construction of the larger hospitals should be violated.

Hospitals are often established by bequests from private individuals and, except in our large cities, are generally small. With the growth of towns and increase of population of the country many new hospitals will be built in a comparatively short time; not less than half a dozen proposed new hospitals for a small number of beds have been brought to our notice within the past two years. In cities it will be found that the medical cases in a general public hospital will be to the surgical cases as two to one; but in the country, if the well-to-do class will do their duty toward the poor, the majority of the sick poor can be best cared for in their homes, and only those cases requiring special medical or surgical skill and the advantage of trained and constant nursing would be sent to the hospital, and of such cases the larger number will be surgical. If the children are placed with the women, the accommodations for the sexes should be about equal.

We will suppose that a careful canvass of the town and neighboring districts has been made to ascertain the necessity for a hospital and the number of beds required to accommodate all the sick poor who actually need hospital treatment, and that, as the result, it has been decided to erect a hospital of seventy-two beds.

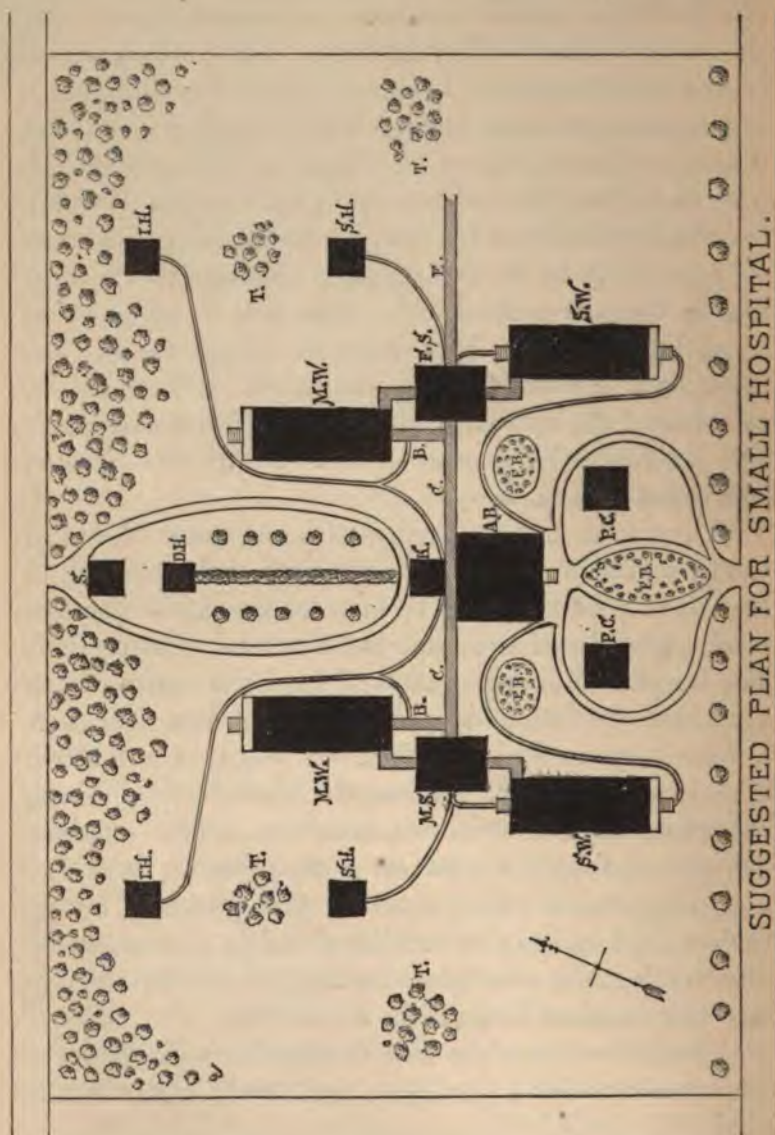
In establishing the new hospital, many difficulties may be expected in the way of securing a good plan. The trustees are pretty sure to be men advanced in years, and very naturally take the advice of men of their own age who are connected with other hospitals, and consequently attached to the old plans of construction. Besides, as the trustees have never made a study of sanitary matters, the strongest tendency, and the one likely to influence their choice of a plan, will be to put up an enduring monument. If the hospital is founded by the generous benevolence of some private individual, the trustees will consider it their duty to see that the buildings are monumental in character. And this feeling will cause them to favor those plans that mass the different parts of the hospital under one roof, and pile the wards one above the other.

The plan that masses all the different parts of a hospital under one roof is the one that is likely to please the trustees, for it is more in accordance with their homes, their hotels, stores, and factories. They can readily see and understand all the points where a plan favors economy and convenience of administration, for all their lives they have studied such questions and found that their success depended upon their appreciation and understanding of these things. If they go beyond this and allow other considerations to influence the plan, it is likely to be in favor of æsthetic effect, and they will in many cases consent to a large expenditure of money and permit encroachments upon the economic arrangements of the internal parts in order to get a handsome and striking building. On the other hand, the plan that aims at making the healthiness of the hospital the first and most important object to be attained,

is objected to wherever it seems to add to the expense, interfere with the convenience of administration, or mar the outside effect of the buildings. The whole question is one of education. Looking at house-building in a broad sense, we find there are four leading ideas that determine the character of a house: First, to have it protect us from the inclemency of the weather; second, to have it convenient for carrying on the necessary work of life; third, to have it appear pleasing to the eye; fourth, to have it healthful. The first belongs to all ages; the second has been more or less perfected; the third, handed down to us by the Greeks, is looked upon as being of the first importance by architects and builders; the fourth belongs to the age of Inductive Science, and is yet in its infancy.

The site should be chosen with the same care as in the case of a large hospital, and with the view that, in time, it may be necessary to increase the size of the hospital, especially if the town is a new and growing one. The hospital should be removed from the centre of the town, and the grounds should be not less than four hundred by six hundred feet. If there is a medical school connected with the hospital, the school-buildings, dissecting-room, laboratories, museum, and the out-door dispensary, should all be on a separate lot from the hospital-grounds. In preparing the grounds, laying the drains, locating the buildings, and in all matters of construction, the principles already given in the chapter on "Construction" should be carried out.

The following plate and description will illustrate what we consider a good plan for a small general hospital:



(The drawing is on a scale of one inch to one hundred feet.)

A. B.	Administrative Building.	S. H.	Special Hut.
C.	Main connecting Corridor.	I. H.	Isolating Hut.
E.	Extension of Main Corridor.	K.	Kitchens.
M. S.	Male Service-room Building.	S.	Stables.
F. S.	Female Service-room Building.	D. H.	Dead-House.
M. W.	Medical Ward.	F. B.	Flower-Beds.
S. W.	Surgical Ward.	T.	Trees.
P. C.	Pay-Cottage.	B.	Bridge from Ward to Corridor.

On the north is a dense grove of evergreen trees to shelter from the winter winds. The other lines represent drives and paths. The dead-house is given a more prominent position in the drawing than was intended, and would be better situated farther from the wards and in a corner surrounded by trees.

LYING-IN HOSPITALS.

Home is the best place for the birth of children, not only on moral but sanitary grounds.

Lying-in wards in a general hospital are no longer admissible, and many authorities are opposed to lying-in hospitals of any kind.

For several days after delivery, on account of the peculiar condition of the parts, a woman is exquisitely sensitive to septic poison, and readily contracts a fatal disease. For this reason it is next to impossible to prevent the women of an obstetrical ward of a general hospital from taking puerperal fever. The large amount of discharge of decomposing matter that naturally follows the birth of a child, although it may not be dangerous to the woman delivered, will in a few days, notwithstanding the greatest care, render the same apartment more or less dangerous to other cases of the same kind, and the danger is greatly increased with every case delivered until puerperal fever breaks out; then it is almost certain death for the healthiest woman to be delivered in the same ward or in an adjoining apartment.

It is true that by great care in keeping everything perfectly clean in and about a lying-in hospital child-bed fever may be avoided, but in time the dreaded disease will show itself, and one case will give off enough poison to infect a whole building and render it dangerous, at least for a season, to all cases of delivery.

A woman in giving birth to a child is safer even in the poorest home on a pile of straw, than she would be in a hospital-ward where there are from ten to twenty

women with new-born infants, especially if this ward is in or connected with a general hospital. When it is possible to give a woman the necessary care during confinement in her home, it should always be done in preference to sending her to the best hospital. In a city certain physicians and nurses should be assigned to the different districts for this duty.

In a large city there will always be a certain number of women who must go to some institution as they have no homes, and for this class accommodations must be provided. But, instead of being treated in the wards of a general hospital, these should be placed in a separate institution, having a medical service of its own—both visiting and resident doctors and all other attendants being held in every way distinct from those of any other hospital.

If the poor even in a very large city are attended in their homes, as has been suggested, the lying-in hospital would not necessarily be very large; under no circumstances should it exceed one hundred beds.

A large lying-in hospital offers excellent opportunities for giving students and nurses the advantages of clinical instruction, but assigning them to attend cases in company with the district physician is for many reasons a much better means of instruction.

PLAN FOR A LYING-IN HOSPITAL.

The selection of the site and the preparation of the grounds, the construction of the raised foundations, and all the details of construction, should be carried out with the same care we have suggested in the plan for the general hospital.

By making a few changes, the plan suggested for a hospital of seventy-two beds could be turned into one for a lying-in hospital—the position and relation of the buildings remaining as in the plate. The huts and cottages, the stable and dead-house, should be very much the same. In fact, the only important changes to be made would be in the internal arrangement of the administrative and ward-service buildings and in the number of beds to each ward.

In or near the administrative building there should be special accommodations for the waiting women whose condition permits light work; this would render the wards less crowded and allow them to be alternately vacated for cleansing and purification.

The ward-service building should have projecting from it a special delivery-ward which should be cut off from the rest of the building by a lobby. The wards should contain not more than eight beds each; they should be thirty feet wide, and allow twelve feet of wall-space to each bed; in other respects they should be the same as the wards of the general hospital. They should be used alternately, one always being left open and exposed to the air; when needed, they could *all* be used—some for those patients confined to their beds, the others for those strong enough to sit up during the day. The patients of the latter class could spend the day in the dining-room of the service-building or in the waiting-ward, and thus allow their wards to be left open, during the daytime at least.

The isolating huts shown in the plan would be useful for infectious cases, and the special cottages would serve for certain other cases which, for good reasons, it would be best to keep out of the wards. By extension

of the main corridor, or covered way, the capacity of the hospital could be increased, but the limit of one hundred beds should not be exceeded. Such a hospital should be superintended by a woman—a lady both by birth and education.

HOSPITALS FOR CONVALESCENTS.

The community which admits the need of a special hospital to which the convalescents can be sent from its other hospitals, virtually acknowledges that its hospitals in use are defective.

Were hospitals built and conducted as we have suggested, cures would be more frequent, prompt, and complete, periods of convalescence would be shortened, and such a thing as a hospital for convalescents, as a separate institution, would be superfluous; unless, indeed, it were situated on a sea-shore or on an elevation sufficiently high to give the inmates a change of climate or at least a different atmosphere, and were used as a place to which certain cases of special diseases, for the successful treatment of which a change of the kind is desirable, could be sent. Still, if the city hospitals now in use are to remain as they are, we too should advocate the establishment of out-of-town hospitals where all cases that could be removed from the immediate care of the doctors and nurses should be sent; for we are satisfied the complete recovery of convalescents would be very much hastened by a removal from the necessarily bad atmosphere of most of the civil hospitals that we have seen. A hospital to supplement badly-built city hospitals should be located on a healthy site accessible to the city, but far enough

away to give fresh air, and in a neighborhood where land is comparatively cheap, so that the hospital-grounds might include a farm on which certain of the patients should labor. If a healthy sea-shore or healthy highlands are accessible, they should be preferred, for the hospital could be made useful not only for convalescents, but special accommodations could be made for a large number of chronic cases that would be greatly benefited by such a change. In this climate (New York City) such a hospital would be of great service, if in connection with it special arrangements were made for giving the sick children of the poorer classes a few weeks of country-life during the hot summer months when the mortality among such children is so very great, chiefly owing to the want of fresh air.

The buildings needed for a convalescent hospital would be: an administrative building containing the necessary offices and dwelling-rooms for the superintendent. Connected with this in the rear should be a general kitchen and two dining-rooms, one for each sex. On either side of this administrative building there should be a long row of simple cottages connected with the dining-rooms by a covered way. These huts should be about twenty-five feet square and ten feet to the eaves, with windows on three sides, and should contain four beds each. No drainage-pipes should be laid on in these cottages. Special arrangements at some distance should be made for water-closets, and, when necessary, earth-closets could be used in the huts. In selecting the occupants for each hut, the strong should be put with the weaker patients and compelled to take care of them, to a certain extent, by keeping their quar-

ters clean, etc. If fuel is expensive, a system of well-arranged barracks might be substituted for the separate cottages, but such a hospital would be chiefly useful during the seven months of the year when fires are not much needed.

In a well-selected place on the grounds, at least two well-constructed general hospital-wards, after the plans we have given, should be erected for the treatment of cases of relapse that are likely to occur, and for certain chronic cases that most need the country air.

A few special isolating huts should be kept for the use of infectious cases that may develop. The success and usefulness of such an institution would, more than in one of any other kind, be dependent upon the character and ability of the superintendent; he should be able to judge character well, for he must decide when and to what extent it would be best for the patient to work; able, also, to detect impostors and malingerers; besides, his work, on account of its being removed some distance from town, would be less inspected than if the institution were more conveniently situated. A convalescent hospital ought to cost comparatively little—light duty being required from all patients who are able to perform it, not only for the sake of economy and discipline, but as a curative measure.

ARMY HOSPITALS.

In the case of hospitals connected with permanent posts, the plans we have given for civil hospitals would answer in every respect; and even in the event of a war, when hospitals must be hastily erected for the sick and wounded, the same principles of construction should be

as closely followed as the circumstances of the case will admit. Every nation going to war should have on hand or get ready a large supply of hospital-tents for use during summer, or whenever the season or climate is not too cold, and a number of one-story wooden pavilions constructed in portable sections so arranged as to be readily put together for use. These pavilions could consist of two parts, the ward and the service-room building. The number of beds should be limited to twenty-eight to each pavilion.

The ward should be twenty-eight feet wide by one hundred and twenty-six feet in length, and twelve feet to the ridge of the roof. The service-room building should be thirty-two feet square, and divided in the centre by a hall with the water-closets or earth-closets, bath-room, and servants' or nurses' room on one side, and a scullery and dining or mess room on the other. The connection with the wards should be by a short corridor.

The pavilions should be raised on pillars several feet from the ground, and, if there is malaria about, the higher the better; and they should be separated from each other and all other buildings by a distance not less than sixty feet. Two or more large stoves, as the climate demands, will be found the most practical way of warming temporary hospitals. The experience of our civil war and the Franco-German War, compared with all preceding wars, shows conclusively that temporary one-story wooden buildings make the best army-hospitals, and save thousands of lives that would be sure to be lost if the sick and wounded were treated in any public or private building that is nearest at hand, as was the custom in former times.

INSANE-ASYLUMS.

To do this subject justice would require much special study, and fill a volume.

In this country most of our institutions are constructed on the massive monumental style, and managed on the economical, prison system, and there is still too much of the iron bars, dark cells, and strait-jackets of the old Bedlam. Besides, the medical attention is scant and necessarily more or less inefficient, and the nursing is wretched; in fact, the nurses do not pretend to be anything more than keepers, and the class from which they are selected is the same as that from which keepers for criminals are derived. Uncommon brute-force seems to be considered the most desirable quality to make a good nurse for an insane-asylum.

On Blackwell's Island, where the largest charitable institutions of New York City are situated, there is an insane-asylum containing thirteen hundred inmates. The large majority of these are in an old building of several stories, with wards for forty or fifty patients each; with the exception of the raving maniacs that are in a badly-constructed lodge, the rest of the patients are in cheap one-story wooden pavilions. At the present time the whole institution is under the control of one paid medical officer, who sometimes has two or three voluntary medical assistants, and sometimes is entirely alone and is expected to render medical assistance to all the patients, and at the same time act as superintendent or executive officer.

At the time of our visit the doctor informed us that he had no hold on his assistants, and could never be

sure how long they would remain with him. There was in the whole hospital one nurse to every twenty-eight patients. In one of the wards intended for forty we found ninety-three patients, and only two nurses in charge.

On the same island, at Charity Hospital, where there are usually one thousand patients, there are, besides a medical executive officer, a house staff of twenty-four and a visiting staff of twenty-seven medical men, or about one doctor to every eighteen patients; while at the insane-asylum, allowing the physician two assistants, there is only one doctor to four hundred and twenty-five patients!

The above account would not fairly represent the condition of all our insane-asylums; but, even in our best institutions for the insane, it will be found that there are several hundred patients to each physician, and the nurses too few in number and not above the grade of common household servants. Some of the buildings are magnificent structures put up at the cost of millions of dollars, but, in our opinion, in many respects unsuited for the purpose they are intended to fulfill.

Of course, dangerous maniacs and raving, acute, insane patients must have special arrangements for their care; but the large majority of the insane can be treated very much as rational beings, and well-trained, reliable nurses in sufficient number would render unnecessary large wards and close confinement, and enable most of the patients to be kept under agreeable and natural conditions conducive to their recovery. And if some of the money expended in fine buildings was used to pay the best medical talent

to devote their time to the study and care of the insane, the results would be much more satisfactory.

More than any other class of patients, the insane are influenced by external conditions that surround them, and that institution is the best which brings its patients under conditions that make the nearest approach to a cheerful and comfortable home.

CHAPTER XI.

HOSPITAL-BUILDINGS NOW IN USE.

HOUSES can be classified according to their different plans, perhaps not so definitely and accurately as a naturalist can arrange the different types of animals or plants, but as readily and understandingly as can be done with the other works of man. In studying over and in grouping the buildings now in use as hospitals, we find many old structures that can be very appropriately called old fossils, and that, judged by their past history, are truly comparable to the largest and the most destructive of the ichthyosaurians of past ages.

Our limited knowledge of the hospitals of India compels us to confine our remarks to those of Europe and America. We will use, for the purpose of illustration, chiefly those hospitals which we have had the opportunity of visiting in person.

We recognize five distinct types in those now existing:

1. The Old Conglomerate, including all extemporized and irregular hospitals.
2. The Old Block Plan.
3. The Corridor Plan.

4. The Pavilion System.
5. The One-Story Pavilion Plan.

THE OLD CONGLOMERATE.

Unless the early Christians borrowed the ideas and adopted the plans of the hospitals used by the ancient fire-worshippers—of which we have no evidence—it is probable that the first hospitals of Europe were certain rooms in or near the monasteries and convents, and were mere appendages to those institutions. During the middle ages the monks and members of the religious brotherhoods were about the only class who understood medicine, and it is likely that the monks and priests distributed medicine and gave advice very much in the same way as is done to-day by our out-door dispensaries. It is certain that they often accommodated the sick in or near their monasteries and churches. From such beginnings some of the most famous hospitals in the world have grown. Of this class the renowned old *Hôtel-Dieu* of Paris is the most illustrious example. This immense old structure stood on both banks of the Seine, with connecting portions lying across and others running under the stream, and only a few steps from the cathedral of Notre-Dame. When we visited it five years ago the wards were filled with patients, and in more ways than one it reminded us of an old, gnarly, weather-beaten oak with a decaying, rotten centre. Its different parts were shaped and arranged with about as little uniformity and evident order as the branches of an old oak, and its wards were about as fit places for the sick to inhabit as the cavities of a decaying tree would be for man to live in. It was founded about the beginning of the seventh century by

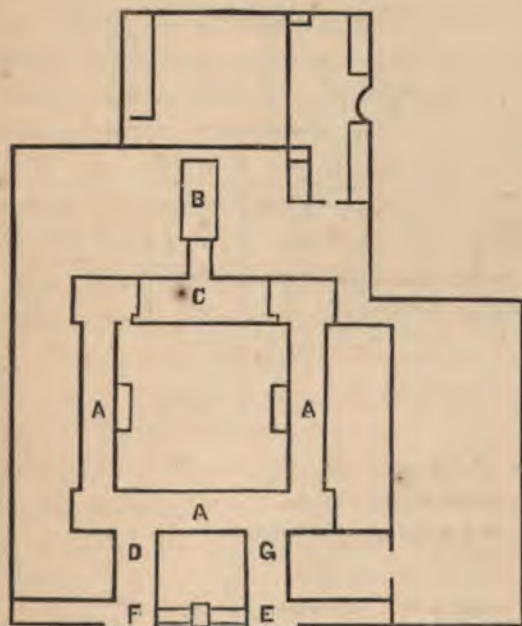
St. Landry, Bishop of Paris, and grew to an immense size; a century ago it contained several thousand beds and from two to six patients to each bed. Early in the sixteenth century the beds were still larger, having from eight to twelve patients in each, and during the prevalence of the plague as many as sixty-eight thousand died within the hospital in one year. Although it was utterly condemned more than a hundred years ago, it was in use as a hospital until within the past few years. Fortunately, there is not such another example, but there are many hospitals that can claim to be lesser evils only on account of their smaller size.

La Charité was originally an old chapter-house. In 1637 it was enlarged and turned into a hospital, and now contains about four hundred beds. *St.-Antoine* was an old convent opened as a hospital in 1795. In 1862 it was enlarged in a quadrilateral form, and now holds four hundred and eighty beds. *Beaujon*, once an orphan-asylum, was also converted into a hospital in 1795. In 1844 new pavilions were added, making the hospital surround a square yard. Several of the other hospitals of Paris were old convent-buildings, and have not been very much altered.

In this country and in England the early history of our hospitals shows the source of some of our faulty hospital-buildings. After it has been decided that a hospital is needed, before the managers or authorities are prepared to build, either from the want of funds or the necessity of the case, some old private dwelling or public building is hastily fitted up and used as a hospital; and finally, instead of putting up a new building, the extemporized hospital is enlarged by changes and additions and indefinitely continued as a hospital. Such

buildings make very bad hospitals, and it is false economy to use any old building, however much improved by additions and changes, for the purpose of treating the sick any longer than absolute necessity compels. The plainest temporary wooden shanties are preferable.

FIG. 1.



HÔPITAL NECKER.

A, wards; B, chapel; C, corridor; D, pharmacy; E, offices; F, dwelling;
G, kitchen.

As examples of extemporized hospitals of the old conglomerate class we take the following: Fig. 1 gives tracings of the ground-plan of the *Hôpital Necker*, of Paris, originally a Benedictine monastery, which was enlarged and turned into a hospital of one hundred and twenty beds, in 1776. In 1862 it was further enlarged

by additions, and now contains three hundred and eighty-six beds. There are three stories of wards, and the buildings containing them surround three sides of a square court, the fourth side being occupied by a gallery. The larger wards contain twenty beds, and the

FIG. 2.



smaller six beds each. The nurses' rooms are between wards, and the closets and baths at the ends of the buildings.

Fig. 2 represents the first floor of *Bellevue Hospital*, of New York City. Two-thirds of the present building now used as a hospital was originally an almshouse and penitentiary, built 1811-'16. At first only a small portion was used for hospital purposes, but during epi-

demics of typhus fever and other diseases, and as the city grew larger, it became more of a hospital. In 1848 the almshouse and penitentiary inmates were removed and a regular medical board organized, and the whole building was used as a hospital. In 1857 the hospital was so crowded that the garrets were used as wards, and it became a necessity to enlarge the building. From 1857 to 1860 renovations were going on: partitions which ran lengthwise in the buildings were cut into arches, the windows enlarged, and on the old portion a third story was added and a new wing built on the northeast, which is a mere extension directly connected with and on precisely the same plan as the old almshouse portion.

From 1860 to 1873 the hospital usually contained from seven to eight hundred patients, and during each year from seven to eight thousand patients were admitted. Several wards were used for lying-in cases, and from four to five hundred women were delivered annually. Of the seven or eight thousand admitted on an average, more than one thousand died in the hospital, making a mortality of one in every seven or eight, or about twelve and a half per cent. of all the patients admitted. During successive years in the printed reports of the hospital, from sixty to seventy deaths are reported as being caused by pyæmia and puerperal fever alone, which is more than six per cent. of all the deaths. From time to time efforts to improve the hospital were made by members of the medical board; the fever and contagious cases were removed and placed in temporary one-story wooden pavilions on Blackwell's Island, and a pavilion-ward was erected on the grounds for erysipelas and other infectious cases. In 1874 a move was made

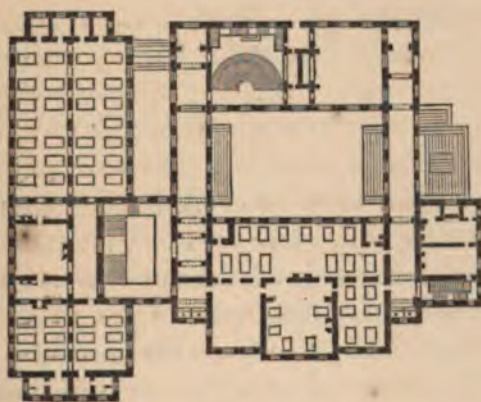
by the State Charities Aid Association to improve the hospital, on account of the excessive mortality, especially among the acute surgical and maternity cases, which was obviously caused by the faulty sanitary condition and construction of the building. Although this move did not effect satisfactorily the object aimed at, still, it was the means of doing good, for, during a fearful epidemic of puerperal fever in the maternity-wards when the death-rate was two out of every five of the women delivered, the lying-in cases were all removed and the maternity-service in the hospital was done away with altogether. Since then the number of patients in the surgical wards has been diminished, and a system of artificial ventilation has been introduced. This ventilating apparatus has proved to be an utter failure. At present the hospital consists of a central administrative part, with wings on either side, three stories high, fifty feet wide, rectangular in shape, and cut up into wards by partition walls, through which doors open directly from one ward to another, while between the wards are the badly-drained bath-rooms and water-closets, with no openings except directly into the wards. Joined directly to these wings, with only a narrow staircase intervening in the passage, are the north and south portions of the building, which are also three stories high, and are divided into wards and arranged in exactly the same manner as the central part, as will be seen by the diagram; some of the wards for twenty beds have only six windows.

Charity Hospital, of this city, built by the municipal authorities as late as 1860, is a massive stone structure, several stories high, and contains usually more than a thousand patients under one roof. The wards are

not unlike those of Bellevue, having their long axis running across the building, thus causing the distance between opposite windows to be very great, and making it necessary to place the beds along the partition-walls, between which are the water-closets, baths, etc.

Irregular hospitals of the conglomerate class are very numerous, and include many famous hospitals. With the exception of the new St. Thomas's, all the important hospitals of London can be classed under this head. Also many hospitals on the Continent, and all hospitals in this country built previous to 1860, except those that we will mention hereafter, must be

FIG. 3.



KING'S COLLEGE HOSPITAL, LONDON.

included. Fig. 3 represents one of the floors of *King's College Hospital*, of London. It is a good example of the irregular class. The building is comparatively of a recent date, put up since 1850, and crowded into a small space near the Royal College of Surgeons, the

object being to have a hospital convenient to the college, while the evident aim of the architect was to get in as many beds as possible. It is a four-story building with an attic, and contains one hundred and fifty beds. The large ward shown in the diagram illustrates a double ward with four rows of beds between opposite windows, a very objectionable plan, but, as will be seen by the following examples of the London hospitals, a style that has been very generally adopted. *St. Bartholomew's* is the oldest of London hospitals; it dates back to 1102. It was rebuilt in 1730. Most of the wards are in three separate buildings four stories in height, with two wards on each floor. The wards are divided by a partition, and have four rows of beds between the windows.

Guy's Hospital was founded in 1722. The old building surrounds two small courts, with extensions inclosing three sides of a larger square in the rear. A new building contains two large wards on a floor, with four rows of beds between the windows, and divided by a partition similar to those of *St. Bartholomew's*.

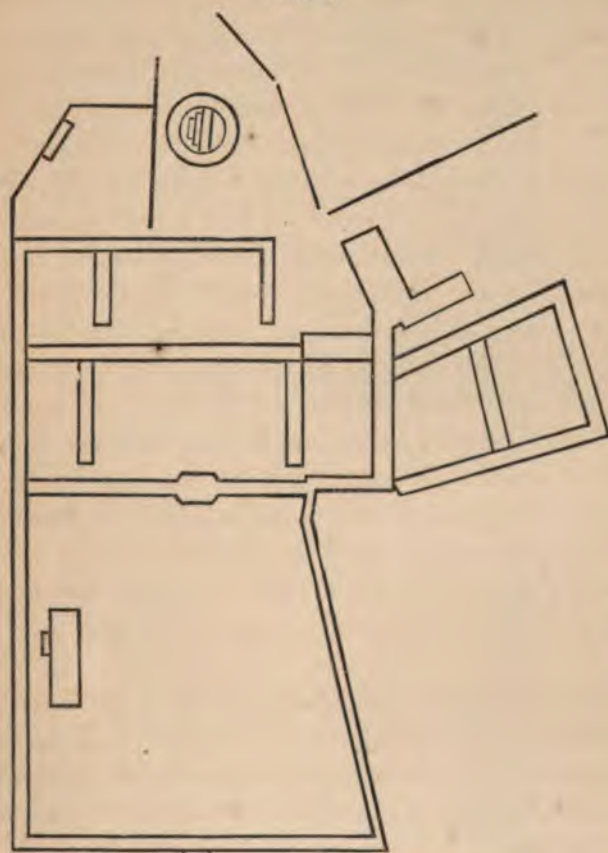
London Hospital, built in 1740, reminded us very much of *Bellevue*; it is of the same shape, and, being in the east end of London, receives the poorest class of patients; most of the wards are divided by a partition-wall as at *Bellevue*, and have four rows of beds between the windows.

Middlesex Hospital is on the block plan, and shaped like the letter H.

Charing-Cross is a solid building several stories high, and contains one hundred and eighteen beds. The wards are almost square, and open directly into each other.

University College Hospital is something like the regular old block plan, but must also be classed as an

FIG. 4.



ALLGEMEINE KRANKENHAUS, OF VIENNA.

Tracings representing the ground-plan of the building. The partitions dividing the buildings into wards are not given in the drawing.

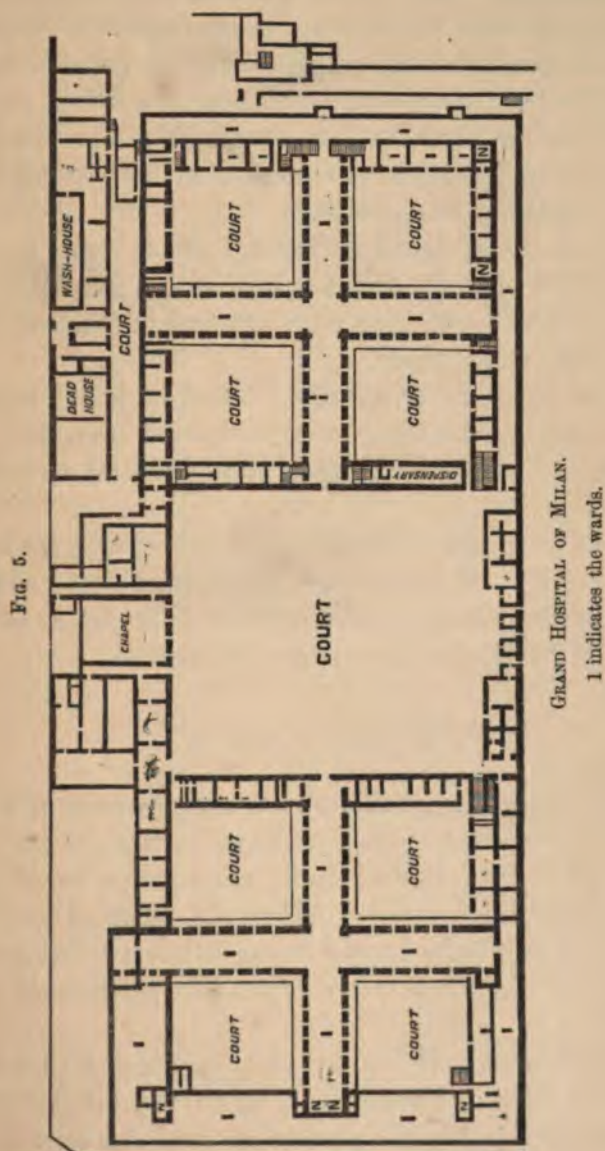
irregular conglomerate hospital. All other English hospitals built previous to 1860, with which we are acquainted, are either irregular as the above, or slightly

modified, but by no means improved, by having portions on the corridor plan.

Fig. 4 gives tracings representing the ground-plan of the *Vienna General Hospital*. The partitions dividing the buildings into wards, etc., are not given in the diagram. As the wards have opposite windows and only two rows of beds, it might have been classed under the old block plan; but it is also very irregular and faulty. This hospital was established by the Emperor Joseph II., in 1784. It has accommodations for three thousand patients, and usually contains as many as two thousand inmates. The wards are constructed on the old block plan and are in buildings two stories high, which, as is shown by the diagram, surround nine different squares or courts that serve as airing-grounds for the patients. There are in all ninety-three wards, of different sizes. The service-rooms are built, as in Bellevue Hospital, between the ends of the wards; the windows are opposite, but placed so high that the patients cannot look out of them. There are four amphitheatres, two dispensaries, two kitchens, and many offices.

Munich General Hospital, founded in 1808, is on the same plan; it contains five hundred beds, and is built around three courts, two large and one small one. But almost all the old hospitals of Germany are on the corridor plan.

Most of the hospitals of Italy are old, irregular buildings. One of the oldest, opened 1456, is one of the monuments of the middle ages, to which we have already alluded in Chapter I. It has fifty-six wards, arranged for over three thousand beds. Fig. 5 gives the outlines of the ground-plan. The two large crosses



represent the main buildings. In the centre of the cross is an altar for holding divine services. The ceilings of the wards are from thirty to forty feet high. Corridors run along both sides of the wards, and the windows are placed above them. The outside wards, completely inclosing the courts, are not so high, and were evidently added later.

St. Louis Hospital, at Turin, was originally a palace, built 1794, and afterward turned into a hospital. It is a two-story Greek cross, with a chapel in the centre, into which the wards open.

The *General Hospital of Madrid* is an immense quadrangular building, several stories high, begun in 1788, and now has sixteen hundred and twenty-one beds.

The hospitals of the conglomerate class have all the faults of the old block plan, and are still used as hospitals either through ignorance or indifference as to what is required for the proper care of the sick.

THE OLD BLOCK PLAN.

The hospitals of this plan usually consist of a solid building several stories high, the central part being used for offices and administration-rooms, with wards in wings on either side. When the hospital is a large one, the buildings extend more or less around a courtyard, and in some cases around two or more courtyards.

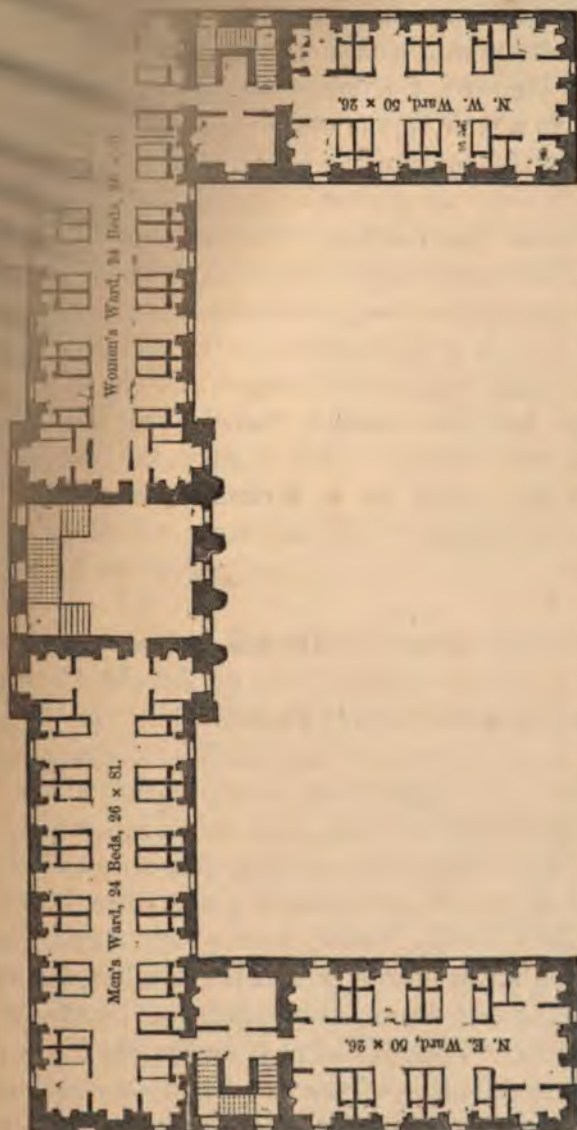
The evident design in adopting such a plan seems to be to save ground-space, make the administration economical, and at the same time establish an imposing and enduring monument. As a rule, managers and

architects have a strong, in fact an almost irresistible, predilection for such plans.

The old *Royal Infirmary*, of Edinburgh, was one of the first hospitals regularly designed and built on the block plan. The history of the establishment of this hospital, as related in a small volume published in 1778, is strikingly like the history of many of our first hospitals, and the plan of the buildings so similar that it is evident the Royal Infirmary is the original model from which the rules and regulations and the style of buildings have been derived. The following account, together with the diagram, was taken from the volume referred to above:

“In the year 1725 the Royal College of Physicians, who had long given gratuitous advice and medicines to the sick poor at their hall, being thus well acquainted with their miserable state, undertook to obtain subscriptions for such a fund; and, as a good example to others, were the first subscribers, and engaged to attend the infirmary regularly in their turns without fee or reward. . . . The subscription of two thousand pounds was no sooner completed, than the College of Physicians called the contributors together, who named twelve of their number as a committee for collecting the money subscribed, for obtaining more subscriptions, and for preparing a plan of management of the infirmary. . . . This committee, having received as much money as, by its annual rent, might maintain a few patients, and having prepared a report concerning the management of the hospital, called a meeting of contributors, where twenty managers were elected, and such regulations as were then deemed necessary were digested and ordered to be printed; and on the 6th of August, 1729, a small

Fig. B.



PLAN OF THE SECOND STORY OF THE ROYAL INFIRMARY AT EDINBURGH.

"This hospital will be open to all the curable distressed from whatever corner of the world they come, without restriction."

PLAN OF PLAN.

As fabric nothing hath been
more than ventilation. In each
ward, those of the wings, are
opened at one end, and a door
opened. In the longer wards,
besides opposite win-
dows, leading to different stair-
cases, likewise a chimney at each
end of the hospital, deemed somewhat
for admission of external air, are
"ventilators." Five years ago
still standing. Several other
buildings, namely the old surgical
ward. For a time the old college
was a fever-hospital: there was
some of these additions are on
newly, new pavilions have been
added to the old infirmary would an-
swer the description of the old *Pennsylvania*
at Philadelphia. In the chap-
ter of "Hospitals" we described its
development, which were
the Edinburgh Infirmary.
The *Massachusetts General Hos-*
pital is on the same plan. The history of
the *Hospital* is also very similar to that
of the Edinburgh, and the new hospital lately
opened on Fifteenth Street by the govern-
ment. The Hospital is on the old block plan,
and the two hospitals might easily
be joined for the other; but the elevation of
the new building overtops that of the old Edin-

burgh Infirmary by several stories.¹ The two were constructed for the same number of inmates (about two hundred). The New York Hospital has all the faults of the old infirmary plan slightly modified by some modern improvements and a very uncertain and expensive system of fan-ventilation; but, instead of being surrounded by four acres of land, it is closely shut in by adjoining dwelling-houses, and an old mansion, used as a library and administrative building, fills up the court formed by the extensions.

Taking either the New York Hospital lately opened or the old Royal Infirmary, of Edinburgh, built a hundred and forty years ago, as being about the best of the hospitals on the old block plan, we sum up our objections under three heads:

1. The wards are placed one above the other.
2. The administrative offices, the kitchen, operating-theatre, the wards, in fact, the whole hospital, is under one roof, and the different parts all communicate more or less directly with each other.
3. The service-rooms are either in or closely connected with the wards.

In the chapter on "Construction" we give in full our reasons for making the above objections.

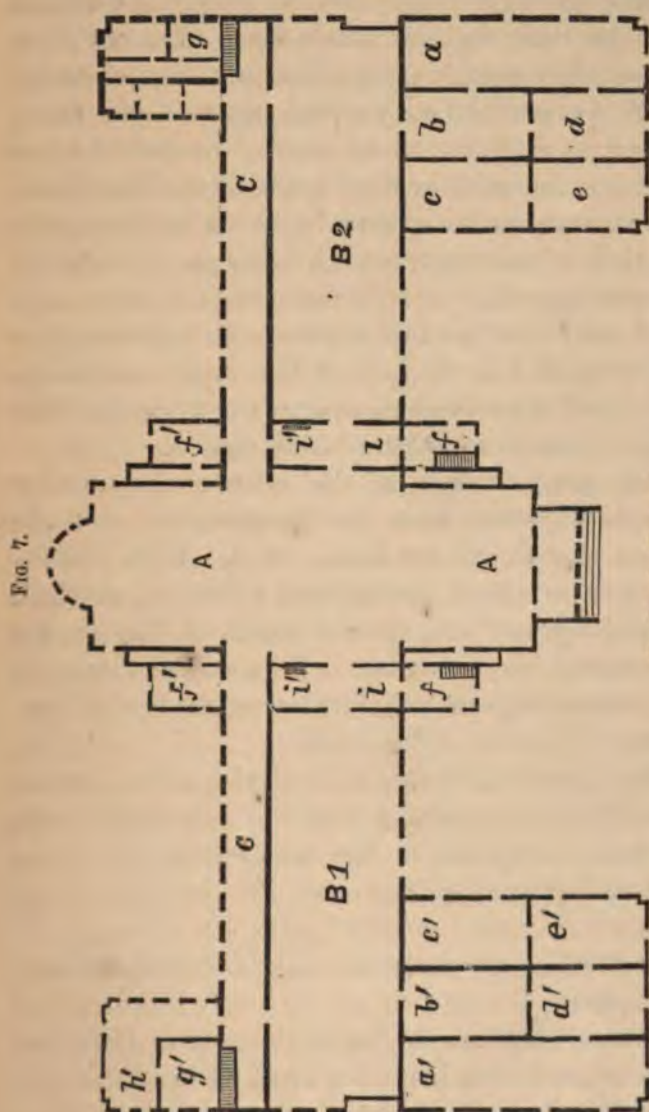
THE CORRIDOR PLAN.

The Grand Hospital of Milan, which we have classed under the irregular conglomerate, is the oldest hospital with corridors, being opened in 1456; but the corridors are on both sides of the wards and attached to the outside of the buildings, instead of being only on one side

¹ We speak of this hospital and give the number of stories on page 35 of Chapter I.

and within the building, as in the regular corridor hospital. We have not been able to trace satisfactorily the origin and development of the corridor plan.

The small hospitals of this class usually consist of a central portion and two wings, the administration offices occupying the centre, and the wards and their service-rooms the wings. The large hospitals, as in the old block plan, are built more or less around a central court. In fact, the corridor plan is the same as the old block, with the addition of a corridor or narrow passageway that runs parallel with the long axis of the ward, having doors and windows opening on the ward. In some cases the corridor runs through the centre of the building, with the wards on either side; in these the wards are usually quite small, being often merely small rooms containing not more than three or four beds each. Fig. 7 is a rough sketch of the principal floor of *St. Luke's Hospital*, of New York. This was the first and the only hospital built on the corridor plan in this country, besides being one of our first church hospitals. It was founded by the late Rev. Dr. W. A. Muhlenberg, of the Protestant Episcopal Church, May, 1854. In the same year a newly-formed church sisterhood opened a temporary hospital in an adjoining hired house. Dr. Muhlenberg, in a short historical sketch, says: "The chapel being finished, was opened for divine service on Ascension-day, 1857, and thenceforward on Sunday afternoons, with the exception of four months in the following winter. This was done in advance of the opening of the hospital, for the purpose of declaring the Christian faith to be the ground and predominating element of the institution. For a year, *St. Luke's* appeared before the public as a church." A year later



ST. LUKE'S HOSPITAL.

The hospital has three floors of wards; those left of the chapel for males, and those on the right for females. A, A, chapel; B 1, B 2, wards; C, C, corridors; a, a, patients' dining-rooms; b, b, nurses' rooms; c, c, medicine-rooms; d, d, pantries; e, e, bath-rooms; f, f, chaplain's room; f, f, stairway; g, g, water-closets; h, h, small ward.

Am Hospital, built in 1850, contains two hundred and sixty-five beds.

Am Hospital, erected in 1850, has two floors of wards and two hundred and seventy-two beds.

Frankfort-on-the-Main Hospital, dated 1833, has two hundred beds.

Both Kiel and Munich have lying-in hospitals connected on the corridor plan.

The ground-plan of the *Alexandrov Hospital*, of Moscow, in shape resembles a horseshoe, with four projecting wings. It is a corridor hospital, built in 1861.

Hôpital Cochin, of Paris, built in 1780, for one hundred and nineteen beds, is a corridor hospital.

Manchester Royal Infirmary, England, erected in 1797, has a corridor running directly through the centre of the building, with wards on either side.

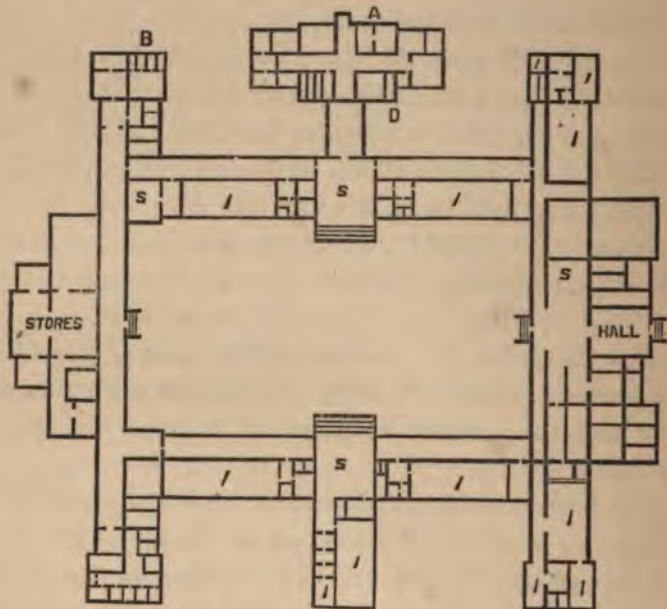
The *Hospital for Consumptives and Diseases of the Chest*, at Brompton, built in 1848, is a regular corridor hospital. Other hospitals of London are partly corridor hospitals.

Fig. 8 gives the ground-plan of the hospital *Rudolphstiftung*, of Vienna. This is one of the latest and most complete of the hospitals on the corridor plan. It was opened in 1865. Except on the east side, the buildings are three stories high. The corridor runs parallel with the wards, and opens into them on the north side. There are, in all, eight hundred beds. In this hospital, and in several others on the corridor plan, an attempt is made to divide the hospital into pavilions by large stairways or by lower buildings intervening, but practically the hospital is still under one roof.

The only rational object that seems to be aimed at, in placing a corridor on one side or in the middle of a

building containing hospital wards, is to afford a means of passing to and fro without disturbing the patients as much as would be done by passing through the wards. Where the building is divided up into a number of small wards or rooms, such a passage-way is necessary.

FIG. 8.



HOSPITAL RUDOLPH-STIFTUNG.

A, administrative offices on the north ; I, wards ; B, baths ; D, dispensary ;
S, stairs.

But one gathers from the old writers, and the talk of old men, that they had an idea the corridor could be used to supply the wards with fresh air without letting in the cold or draughts, and that the stairways were the great ventilating wells. But we know now that the corridors running parallel with the wards not only

interfere with through-ventilation from side to side and intercept sunlight, but that they serve as foul-air channels to convey the tainted air from one ward to another.

Previous to the completion of the Lariboisière and to the Crimean War, and the books of Miss Nightingale, little was generally known about sanitary laws, and the corridor plan was copied simply because it was about the only recognized design that was a departure from the old conglomerate hospitals of the past, and did not interfere with the desire of the founders to erect a monument, nor with the ambition of the architect to construct an imposing edifice on a small space of ground. We consider that corridor hospitals have all the faults of the old block plan, namely: the whole hospital being under one roof, the wards placed one above the other; the service-rooms in close proximity to the wards; and, besides, corridors that make ventilation more difficult intercept sunlight, and add to the cost of construction.

THE PAVILION SYSTEM.

In Chapter I. we gave some account of the origin and development of the pavilion plan. Miss Nightingale, in her "Notes on Hospitals," says: "The first principle of hospital construction is to divide the sick among separate pavilions. By a hospital pavilion is meant a detached block of buildings, capable of containing the largest number of beds that can be placed safely in it, together with suitable nurses' rooms, ward sculleries, lavatories, baths, water-closets, all complete, proportioned to the number of sick, and quite unconnected with any other pavilion of which the hospital may consist, or with the general administration offices,

except by light, airy passages or corridors. A pavilion is indeed a separate detached hospital, which has, or ought to have, as little connection in its ventilation with any other part of the hospital as if it were really a separate establishment miles away. The essential feature of the pavilion construction is that of breaking up hospitals of any size into a number of separate detached parts, having a common administration, but nothing else in common. And the object sought is, that the atmosphere of no one pavilion or ward should diffuse itself to any other pavilion or ward, but should escape into the open air as speedily as possible, while its place is supplied by the purest air from the outside."

The first hospital with separate pavilions, so far as we can learn, was erected in 1756-'64 at Stonehouse, near Plymouth, England. The famous report of the committee of the French Academy of Sciences was made in 1786.

St. André General Hospital, of Bordeaux, founded in 1390 and rebuilt 1829, was the first complete hospital constructed according to the principles laid down by the report of the Academy's committee. It has six hundred and fifty-four beds in twenty-four wards; the pavilions are arranged on either side of an open court, around which runs an open gallery or corridor connecting the pavilions on the ground-floor.

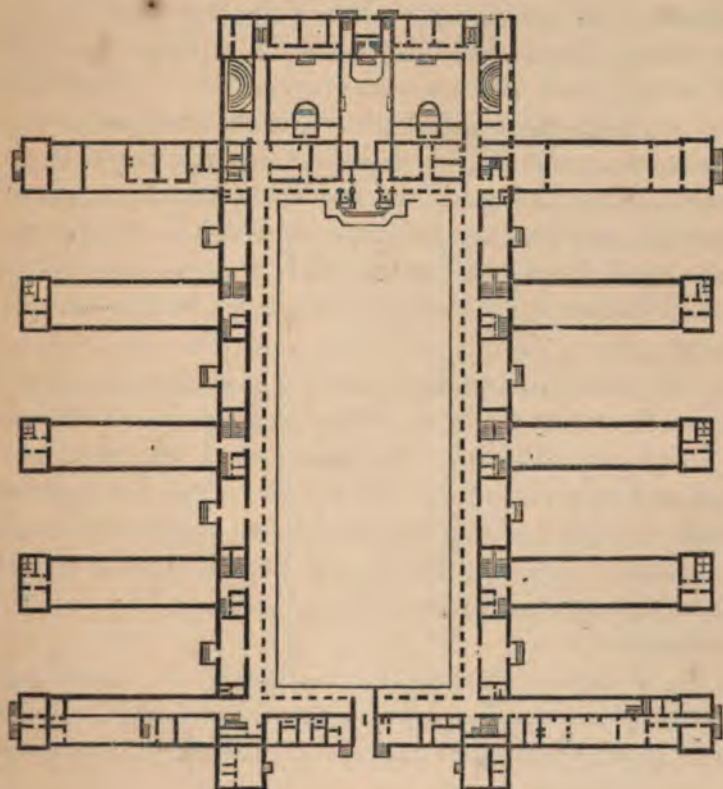
Hôpital St. Jean, at Brussels, was completed in 1843. It consists of ten pavilions, only thirty-five feet apart, and connected by a two-story corridor.

Hospital La Princesse, of Madrid, is a modern building on the pavilion plan. There are eight pavilions, four on each side of a large inclosed space, and

connected by a corridor. It contains three hundred and fifty beds.

Fig. 9 is the ground-plan of *Lariboisière*, commenced

FIG. 9.



HÔPITAL LARIBOISIÈRE.

in 1846, on plans furnished by Gauthier, and finished in 1854.

This hospital consists of a series of pavilions, arranged on two parallel lines, separated by an inclosed space laid out as a garden. There are six of these

detached buildings for patients, containing in all six hundred and six beds: in front are buildings for the offices, kitchen, and pharmacy, parallel with those for the sisters and attendants, the laundry, chapel, operating-room, baths, etc., at the end farthest from the entrance. The pavilions contain three floors of wards; one large ward for thirty-two beds, and one small adjoining ward for two beds on each floor. Each ward has a sister's room and scullery; at the ends are closets, baths, etc.; and a spacious staircase gives access to the wards. All the pavilions are connected by a glazed corridor, one floor in height, over which is an open terrace, used by convalescents, and also as a means of access between the first floors when the weather permits.

Any one visiting this splendid hospital with its polished floors, its walls of Parian cement, its costly machinery for artificial ventilation, etc., etc., would be inclined to think that it is perfect—that the patients must do well. But time has shown a different result. Its records give a mortality but little less than that of the old hospitals. It may be well asked, Why is it not a success?

1. Forced or artificial ventilation cannot with safety be made to take the place of natural or normal circulation of unadulterated, fresh air, purified by the direct rays of the sun.

2. The area on which the buildings stand is too small for a hospital of six hundred and six beds.

3. The pavilions are three stories high and only sixty feet apart, which is not sufficient space to allow a free circulation of air.

4. The wards all communicate with a stairway at

one end, so that impure air readily passes from one to the other; and, as the pavilions are connected by large, spacious corridors, without doubt air is often interchanged from one pavilion to another.

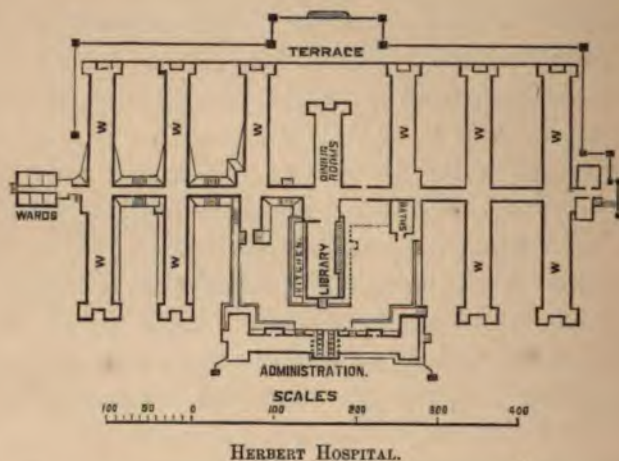
5. The closets, baths, and sinks, are placed at the ends of the wards, so that a current of air passing from end to end in the ward is liable to be made impure at all times.

6. The pavilions are arranged around a court.

New St. Thomas's Hospital, in London, with the exception that the pavilions have four floors of wards instead of two, is built after the plans given in Miss Nightingale's book, "Notes on Hospitals." On the Thames embankment the eight pavilions of St. Thomas's Hospital rear their stately façades for a quarter of a mile opposite the Houses of Parliament and Westminster Abbey. These pavilions are built of red brick, faced with sandstone, and covered with slate. They are situated about one hundred feet apart, the first and second stories being connected in front by corridors. The dispensaries, drug-shop, etc., form a part of the corridors. The pavilions at either end are appropriated, one to the executive offices, and the other to the medical college. The hospital contains twenty wards, having from twenty to twenty-eight beds each, with a small ward of two beds attached to each, the sixth pavilion being used for infectious cases, and containing seven wards of eight beds each. It is without doubt the most magnificent hospital, and perhaps the finest structure used for charitable purposes, in the world. The administrative and executive facilities could not be more complete, even to the smallest detail; neither space nor cost has been spared.

Although free from some, yet it has most of the same serious faults which have been enumerated while speaking of the Lariboisière, namely: The pavilions have too many stories; the corridors are so constructed that there must be more or less intercommunication of the atmosphere of one pavilion with another. The nurses' room, small ward, etc., block up one end, while the closets and baths fill up to a great extent the other end of the wards. It is a great improvement on the old plans;

FIG. 10.



but so far the practical results have not been altogether satisfactory.

Fig. 10 represents the ground-plan of *Herbert Hospital* at Woolwich, built in 1863. At the time of its erection it was considered by Miss Nightingale as fully carrying out the true principles of hospital-construction. It consists of four double and three single two-story pavilions on a raised basement, connected by a corridor through the centre. The corridor is of one story, with a

basement. There are six hundred and fifty beds. The wards are twenty-six and a half feet wide, fourteen feet long, and each bed has ninety-five superficial feet and fourteen hundred cubic feet of space. To every two beds there is one window.

The late writers on hospital-construction, as Galton, also put forward the Herbert Hospital as a model. We would make the same objections that we made to New St. Thomas's, for, with the exception of being two stories only to the pavilions, it is almost exactly the same.

Blackburn Infirmary, England, commenced in 1859, was one of the first pavilion hospitals built in England. It occupies eight acres of land, not far from Manchester, and is composed of six detached two-story pavilions running right and left from a connecting corridor.

Glasgow Surgical Hospital is a pavilion hospital built in 1860. It has one hundred and ninety-eight beds—eight wards of nineteen beds each—two wards to a floor, with a staircase between them. The wards are closed at both ends.

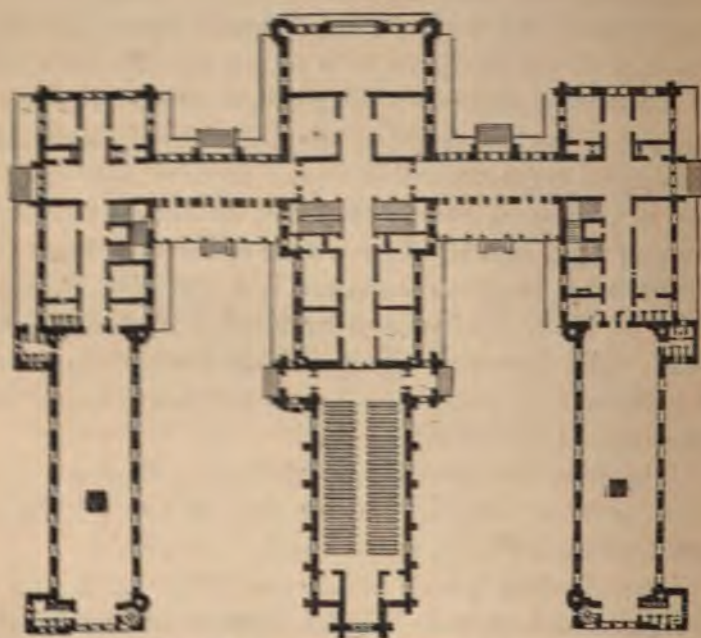
The *New Infirmary* built at Leeds, England, is a large pavilion hospital. It consists of five buildings, each two stories high, connected by a corridor.

The *Chorlton Union Workhouse Hospital* is also a new pavilion hospital. In fact, throughout the United Kingdom of Great Britain the teachings of Miss Nightingale are generally accepted and carried out wherever new hospitals are built.

Fig. 11 gives the plan of the *Hospital of the Protestant Episcopal Church*, of Philadelphia. This was the first hospital constructed in America in which the suggestions of the French Academy's committee were carried out. Mr. Samuel Sloan was the architect. The

corner-stone was laid May, 1860. The hospital consists of a central administrative building, containing a very large chapel, operating-theatre, and offices. On either side parallel with the administrative building are the detached pavilions containing the wards. In each pavilion there are two floors of wards above the base-

FIG. II.



HOSPITAL OF THE PROTESTANT EPISCOPAL CHURCH, OF PHILADELPHIA.

ment, besides an attic in which are rooms for special cases. These pavilions are connected with the administrative building by a two-story corridor running at right angles with them. The wards are one hundred and twenty feet long, thirty feet ten inches wide, by sixteen feet in height, and contain thirty beds each.

In 1863 the *Boston Free City Hospital* was partly built. The original plan consisted of a grand central administrative building, connected with six widely-detached, three-story pavilions by curved, one-story corridors. Only two of the pavilions on the old plan were erected. Within the past three years several one-story pavilions have been built on the grounds.

In 1867 one of the pavilions of the *New York State Woman's Hospital* was opened, and the second pavilion was finished a few months since. The buildings are handsome structures, with four floors of wards, and together can accommodate one hundred and thirty-five patients. The two pavilions are almost exactly alike. In the basement are the kitchen and store-rooms. The first floor is divided by a hall and partitioned into private rooms. The second and third floors are alike, and have fourteen beds each. The fourth floor has twenty-four beds. Each ward has its water-closets and bath-room and nurses' room, or small ward, at one end, where there are a service-staircase and dumb-waiter from the basement to the top ward; and at the other end are a wide stairway and an elevator for carrying up patients—one of the first ever introduced into a hospital for that purpose. There are also in this end the reception-room, office for the house-surgeon, and an operating-room. The pavilions are situated with their long axes east and west; consequently the sun shines only on one side.

The cases treated in this hospital are confined to diseases peculiar to women; no lying-in women are received. The author resided in the older of these pavilions as house-surgeon for eighteen months, and knows from personal experience that the whole build-

ing had a common atmosphere; that the patients on the fourth floor could not help knowing what they were to have for dinner long before it reached them; and that patients in all the wards suffered from malarial poison arising from defective drainage in the cellar. After the buildings had been in use a few years, it began to be risky to operate upon certain cases, and within the past few months it has been decided to erect huts or cottages for the cases of ovariectomy, as lately nearly all such cases operated on have died.

Since the erection of the first pavilion of the Woman's Hospital several new hospitals on the pavilion plan have been built in New York City, or at least partly built, one or more pavilions of each being completed, and are now in use. The largest of these is the *Roosevelt Hospital*; that is designed for three hundred beds, and now has room for one hundred and eighty; one of the pavilions of this hospital is only one story high. We will speak of it again.

Mount Sinai Hospital for 160 beds, is completed.

The *German Hospital* has one large pavilion completed; and the *Presbyterian Hospital* has an elegant administrative building, kitchen, laundry, steam-engine, etc., but only one central pavilion finished for seventy beds.

To criticise one of these is to criticise all, for they are on very much the same plan, all three or four stories high, with service-rooms, etc., at the ends, and all, except the Roosevelt, have the pavilions so placed as to get sunlight only on one side.

There is a hospital in Providence, R. I., the *Rhode Island Hospital*, on the pavilion plan, very much the same as the new hospitals of this city.

San Francisco, California, has a large, two-story pavilion hospital situated in spacious grounds. Chicago is to have a large pavilion hospital; one of the pavilions, of several stories, has been built. There are several other smaller ones in the United States on the same plan.

The regular pavilion plan is but a modification of the old block plan, and we have exactly the same objections to it. We cannot say that all the hospital is under one roof, but, where there are more than thirty patients to the pavilion, we do say there are too many patients under one roof. The wards are placed one above the other, and the service-rooms are in close proximity to the wards.

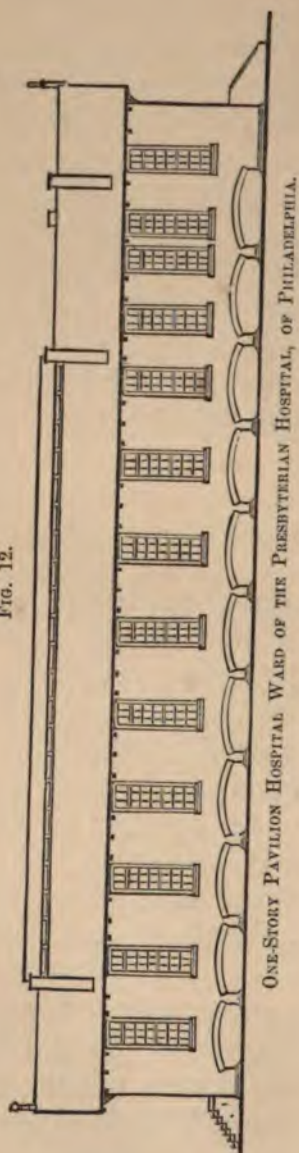
THE ONE-STORY PAVILION PLAN.

The principles of the one-story pavilion or barrack plan are precisely those laid down by the committee of the French Academy and taught by Miss Nightingale, but the pavilions are all limited to one story in height and to one ward to each pavilion. In Chapter I. we have described their origin and development.

Fig. 12 gives the plan of the one-story pavilion of the *Presbyterian Hospital*, of Philadelphia. This building was completed in 1875, and illustrates very well about the best of the one-story pavilions that have been erected.

As will be seen by comparing this diagram with the plate giving our drawing for a surgical pavilion, the plans are somewhat alike; but in this the service-rooms are in the same building as the patients, the windows are too few, the beds too close together, and the

Fig. 12.



ONE-STORY PAVILION HOSPITAL WARD OF THE PRESBYTERIAN HOSPITAL, OF PHILADELPHIA.



sitting-room at the end of the ward interferes with the ventilation.

In this country a number of one-story pavilions, in connection with large civil hospitals, have been erected since the civil war. On Blackwell's Island the New York City authorities had a number of simple wooden, one-story pavilions built on the plan of those used for the temporary hospitals during the war. The first were fever wards, but lately all the new buildings for the sick are on the one-story plan, and at present two one-story pavilions, to be used as a lying-in hospital, are being constructed in which the wards will be separated from the service-building by a space of ten feet and connected by a short straight corridor. One of the surgical wards of the Roosevelt Hospital is in a handsome one-story pavilion; but the building has a cellar beneath it, and at the end adjoining the corridor are all the service-rooms except the water-closets and baths, which are in a small structure projecting from the side of the ward near the centre—a very objectionable place.

In Boston there are several one-story pavilion wards; those on the grounds of the Boston Free City Hospital are of the usual rectangular shape, with service-rooms directly connected with wards. One of the pavilions of the *Massachusetts General Hospital* has a square ward similar to that given by one of the essayists in the Johns Hopkins Hospital book, a review of which will be found in our Appendix.

The plans for the *United States Marine Hospital* at San Francisco, California, are one-story pavilions, like those used for army hospitals during our civil war.

In Great Britain the *Glasgow Fever Hospital* was one of the first one-story pavilion hospitals erected.

It consists of four parallel double pavilions one story high. Three are built of wood on brick pillars. The fourth is of brick with hollow walls. There are ridge-sashes and opposite windows. There are eleven beds to the ward, and a small ward adjoining.

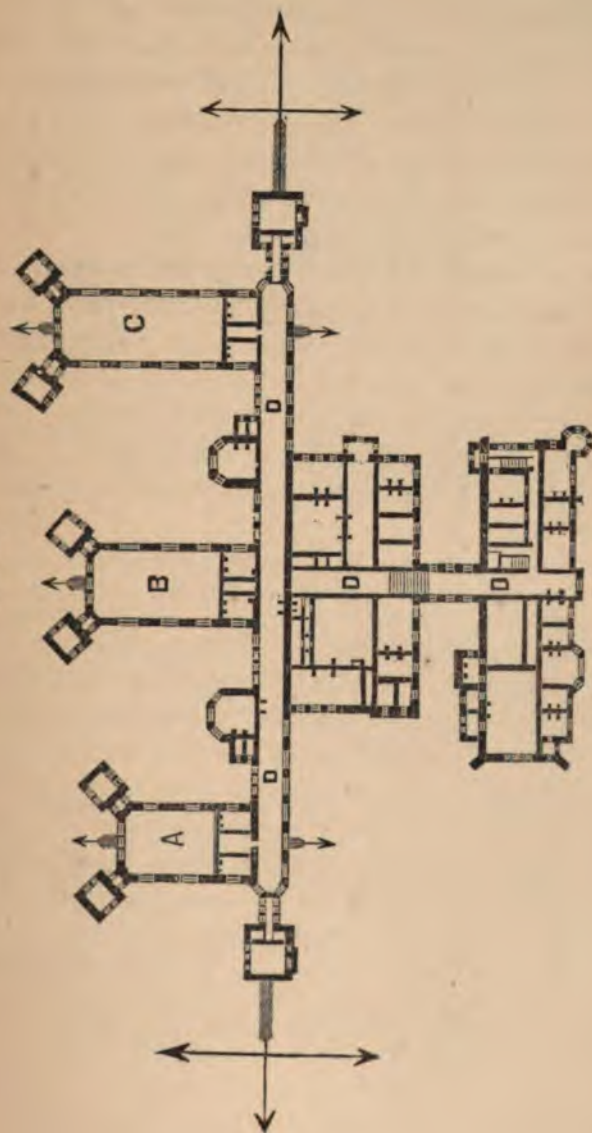
Fig. 13 gives the plan of the *Rotherham Hospital*, built in 1872. This is one of the best and most complete small hospitals in England. The buildings are of stone. The pavilions are one story high, and raised some distance from the ground, and sixty feet apart. The water-closets and baths are in the small projections at the free ends of the wards. The small buildings at the ends of the corridors are wards for special cases, and the two between the pavilions are wards for convalescents. The pavilions contain respectively twelve, ten, and eight beds.

During the late Franco-German War both parties, especially the German, adopted the American system of erecting large temporary hospitals, composed of a great number of one-story pavilions, built of wood, and in some cases connected with the administrative building and with each other by a corridor.

Dr. Esse had a one-story wooden pavilion erected in connection with Charity Hospital, of Berlin, in 1867, and since then several civil hospitals on the American one-story or barrack plan have been constructed, two of which we speak of in Chapter I.—one at Leipsic, the other at Kiel. The new *City Hospital* at Friedrichshain, Berlin, built in 1870, is a pavilion-hospital. Some of the wards are in one-story and others in two-story pavilions. The pavilions are widely detached, and have no connecting corridors—only gravel-walks between.

To the best of the one-story pavilions we can make

FIG. 13.



ROTHERHAM HOSPITAL, ENGLAND.
Scale, sixty-four feet to an inch.

but one of the three objections which we made to the old block plan, for the hospital is not all under one roof, nor are the wards placed one above the other; but the service-rooms, namely the water-closets, the bath-room, the nurses' room, the scullery, and in some cases a small ward, are all directly connected with the ward under the same roof, and always blocking up one and in many cases both ends of the ward.

How to correct the above faults, and to erect a hospital on an improved one-story pavilion plan, we endeavored to show in the chapter on "Hospital-Construction."

APPENDIX.

A Review of "Five Essays relating to the Construction, Organization, and Management of Hospitals, contributed by their Authors, for the Use of the Johns Hopkins Hospital of Baltimore." Large 8vo, pp. xxi.-353. Numerous Plates. New York: William Wood & Co., 1875. (Review written for the Standing Committee on Hospitals, State Charities Aid Association, at the request of Mr. King.)

THE object of this book is fully and clearly stated in the letter of Mr. King, the President of the Board of Trustees, and may be given in a few words. The late Johns Hopkins, a wealthy citizen of Baltimore, bequeathed several million dollars (now estimated to be \$6,000,000) to trustees, with which to found a university, a colored orphan asylum, and a hospital, and he added fourteen acres of land in the city of Baltimore, on which the hospital is to be built.

In a letter to the trustees Mr. Hopkins very definitely describes his wishes concerning the trust.

The hospital is to be a general medical and surgical hospital, and to contain four hundred beds¹ when finished. The sick poor, without regard to sex, age, or color, are to be received into it free of cost, and a number of beds are to be provided for strangers and others able and willing to pay. The hospital is to have a training-school for nurses established in connection with it, and is to be used to afford clinical teaching for the medical school of the university.

In his letter Mr. Hopkins enjoined the trustees "to obtain the

¹ Working basis reduced now to three hundred beds.

advice and assistance of those at home and abroad who have achieved the greatest success in the construction and management of hospitals." In accordance with this request the trustees selected

JOHN S. BILLINGS, Brevet Lieutenant-Colonel and Assistant Surgeon, U. S. A. ;

NORTON FOLSOM, M. D., of Boston ;

JOSEPH JONES, M. D., of New Orleans ;

CASPAR MORRIS, M. D., of Philadelphia ;

STEPHEN SMITH, M. D., of New York—

each to prepare an essay upon the construction and organization of the proposed Johns Hopkins Hospital.

* Before taking up the discussion of the essays, we must speak of the "Letters of Instruction" that preface them, one from Mr. Hopkins to the trustees, the other from Mr. King, the President of the Board of Trustees, to the authors of the essays.

Dr. Folsom in his paper, speaking of Mr. Hopkins's letter addressed to the trustees, very aptly says: "It evidences not only benevolence, but wisdom. It shows not only solicitude for the welfare of the poor and suffering, but a keen appreciation of their necessities, and discriminating skill in planning their relief." Mr. Hopkins has not alone shown his wisdom and practical judgment in defining his wishes, but has displayed equal foresight in the selection of the men who are to carry out his intentions. We speak of this, because, in a great majority of instances, trustees of hospitals are chosen mainly on account of high social position, or for generous contributions to the finances, and seldom have much actual practical knowledge about such institutions. Mr. King's letter shows plainly that, if he has not had actual experience in hospitals, he has at least made himself familiar with their organization, construction, and management, and that he has broad and comprehensive views upon the subject.

The steps so far taken by the trustees of the Johns Hopkins fund toward the building of the hospital are in striking contrast with those pursued by *most* boards of managers of hospitals, and we believe that the contrast will be still more marked in the future when a comparison can be made between the practical workings of the various institutions.

The only fault we have to find with Mr. King's letter of instruction is, the short time allowed for preparing the essays ; it should

have been six instead of two months. To this unavoidable haste we are inclined to attribute the marked want of completeness that is noticeable, with one exception, in all of the five essays.

DR. BILLINGS'S PLAN.

The first essay is by J. S. Billings, M. D., who begins his paper with some good suggestions about the medical school.

The remarks on organization and management are very general, and some important points are treated of in a very few lines. For instance, a mere reference is made to the training-school for nurses, for which it is observed a separate building should be prepared; but no plan of organization is given, nor is the subject again referred to.

"On the Causes of Hospitalism; or, the Hurtful Influence of Hospitals," an interesting chapter is given: not that there is much that is new in it, but that it is a clear statement of the nature and action of hospital poisons, so far as these are understood, and is not to be found in other books on hospital-construction.

What Dr. Billings has to say about temporary *versus* permanent hospitals is exceedingly interesting. He begins by giving his reasons for having advocated the proposition a few years since, that "no hospital should be constructed with a view to its being used as such for more than fifteen years." After stating under what circumstances he did so, he says: "But the statement that this temporary character should be adopted for all hospitals and especially all parts of hospitals, was, I am now satisfied, too sweeping." He then makes some remarks both for and against the barrack-system, and concludes as follows: "I am of the opinion that all the good qualities of a barrack or tent hospital can be combined with those of a permanent structure in such a manner as to secure both the healthfulness of the one and to a considerable extent the convenient and economical administration of the other, and such a plan I will attempt to indicate." We, too, believe that such a building can be adapted to the successful treatment of the great majority, but not of all classes, of cases.

Dr. Billings next takes up the question of heating and ventilation, his plan for which, he candidly admits, will be an experiment. In his discussion of the subject and in his assertion that two-story

pavilions may be made to furnish results equal to those of one story, especially in a case like this where land is abundant, he appears to us to give too much weight to theoretical views, and shows a tendency to overlook the results of experience, and to follow in the same steps that have led to the erection of all our magnificent civil hospitals, which he nevertheless admits to have been failures.

It is indeed difficult to understand why methods of ventilation, theoretically so complete and perfect, have failed to give good results when put in practice. And yet it is a fact that, so far, simple one-story buildings, with but little or no mechanical contrivances to perfect the ventilation, have given the best and the only satisfactory results in the treatment of a large and important class of patients; while, on the contrary, those hospitals constructed at a great cost with (from a theoretical standpoint) all the necessary contrivances for making the ventilation a near approach to perfection, as, for instance, Lariboisière, have failed to give as good results as similar buildings without the mechanical ventilating apparatus.

The general plan for the wards and service-rooms, in Dr. Billings's essay, does not differ essentially from that recommended by Miss Nightingale.

We think the plan of having the wards raised on basements so that the top of the corridor may serve as a walk on a level with the floor of the ward a good one, and we approve of the wall and the cubic space allowed each bed, and the number of beds to each ward; but we think the service-rooms and the small wards take up too much space, and will make the plan expensive, besides blocking the end of the ward.

We would separate, in fact isolate, the service-rooms from the ward, placing them near the end of the ward, a little to one side of and connected with it by means of a short corridor. The object thus aimed at is—1. To avoid the danger which is to be apprehended from the proximity of the numerous partitions, doors, etc., as affording places for harboring infection; and from the emanations from water-closets, drains, sinks, and dining-rooms; 2. To diminish the risk of the foul air of one ward reaching other wards by means of the corridors; 3. To leave the ends of the ward free, so that a current of air can pass through the ward as readily from end to end as from side to side; 4. That if need be, on account

of the ward becoming infected, it can be destroyed, leaving intact the basement and the service-rooms.¹

Instead of the plan given for the private or pay patients' pavilions, we would have them similar to the pavilions for the other patients, with this difference: they should be forty feet wide in place of thirty, so as to allow for a corridor in the centre with rooms on both sides, say twelve by fifteen feet each, heated by an open grate. The ward containing the rooms should be as completely separated from the service-rooms as was recommended for the others.

After reading Dr. Billings's remarks on hospitalism, we are surprised to find him recommending that the amphitheatre for operations should be crowded into the same building with the *post-mortem* and pathological rooms. If what he says about these "disease-germs," these little infectious floating particles, is true, then every patient operated upon and every wound exposed in the operating-amphitheatre would be liable to be poisoned—infected with a fatal disease—before they enter the wards.

If the *post-mortem* and pathological rooms are placed on the grounds at all, they should be in one corner of the lot, as completely isolated as possible. They should, under any circumstances, have all attendants, both medical and others, entirely distinct from those of the hospital, and the buildings might very well be separated from the rest of the hospital by a high stone-wall. The operating-theatre should be kept as well ventilated and as pure and fresh as the wards themselves.

Under the head of "General Plan of Hospital" Dr. Billings gives some good suggestions on the classification of patients; and, although we think to carry out this to the extent he recommends will be a difficult matter, still, it should be done as far as is practicable.

Judging from what we know of pavilions of one, two, and three stories, erected in this city, Boston, and Philadelphia, it strikes us that Dr. Billings's estimate of the cost of his buildings is too low by at least one-third of the amount given.

¹ A full description, with drawings and plan for carrying out this idea, was given in a paper read before the State Charities Aid Association in New York, December, 1873, and a brief reference to it published in the report of the special committee appointed to take active measures for the erection of a new Bellevue Hospital, February, 1874.

If Dr. Billings's one-story plan is adopted, we do not hesitate to say that the hospital would be a very great improvement upon any other in this country, but we cannot accept his essay completely, and sum up our objections as follows :

1. He is too general in his remarks on the organization and management of the hospital.

2. In his plan for the pavilions he does not recognize the advantage of separating the ward from the service-rooms, and favors too much the idea of two stories under circumstances where the question of sufficient ground cannot arise.

3. His plan of heating and ventilation, as he himself admits, is an experiment, and when the plans are closely examined we find the fresh-air and foul-air ducts placed one directly above the other, so that, unless at a great expense these ducts are made impermeable to air, there will be a constant interchange of their contents ; and if we are to believe the teachings of Pettenkofer, that almost everything is permeable to air, it will be next to impossible to make the separation complete, arranged as Dr. Billings has them.

4. In his plan for what he calls the third building, which "is to contain the amphitheatre, out-door dispensary-rooms, dead-house, and pathological laboratory," he violates the plainest sanitary law, and contradicts his own teaching given in previous chapters.

5. We do not consider his plan of arranging the pavilions the best, either for the good of the patient, or the convenience and economy of administration. It has the merit of being uniform and well-balanced, but in his plan for the one-story pavilions (Plate IV.) these are too close to each other, and the private wards too near the administrative building.

DR. NORTON FOLSOM'S PLAN.

Dr. Folsom's plan for the pavilions, the wards which he terms "isolating wards," and the autopsy-building, together with his method of heating and ventilation, is similar to that of the Massachusetts General Hospital now in use.

The principles are exactly the same, but the details, especially those relating to the administration, are more elaborate and are in many respects improved. Dr. Folsom adopts one plan for all his

wards, except for the wards he calls "isolating wards," and does not speak of having his surgical wards differ from those of the medical, and does not provide for a proper classification of diseases.

In reference to the training-school for nurses, we think he has misinterpreted the intentions of the founder when he proposes to limit it to the use of the hospital. We believe that it was the design of Mr. Hopkins, not merely to afford women wishing to become nurses the opportunity of serving in that capacity in the wards, but to establish a training-school in which the didactic part of a nurse's education—of which Dr. Folsom thinks so little—should be begun and developed until the profession is made an honorable one, and nurses are raised above the level of servants.

Dr. Folsom decides in favor of having all the buildings in which the patients are treated only one story high, but also decides that all parts of every building should be permanent in construction. To this, as we have said before, we object. All wards for acute surgical and fever cases should be so constructed as to be readily destroyed and renewed; for other cases not liable to become infected, the wards may be permanent in character.

The buildings in Dr. Folsom's plan are well arranged for the convenience of administration, and so placed that the medical superintendent can readily supervise all the workings of the hospital; but, in our judgment, the general plan is in several respects objectionable:

1. The administrative building, dispensary, operating-theatre, kitchen, laundry, autopsy-rooms, and the dead-house, are situated on the west and southwest side of the grounds, exactly in the position to intercept, during the summer, when the windows and doors are open, the prevailing wind, and to permit the poisoned atmosphere from these buildings to be carried directly into the wards.

2. We cannot see the necessity of crowding together the laundry, autopsy, dead-house, boilers, and kitchen, nor for having the operating-theatre in such close proximity to the *post-mortem* rooms.

3. The dispensary service and that of the hospital are in common, using the same pharmacy, etc. Such an arrangement may do in a small hospital, but, for one of three or four hundred beds, there will be, aside from the necessarily great risk of infection, and

the unavoidable filth and dirt, much confusion if the out-patients are to use the same entrance as the inmates of the hospital. It is obvious that it would be difficult to keep order, if the out-patients, of whom nothing is known, were allowed the freedom of the grounds, and of at least a part of the main corridor in which the attendants are constantly passing. Dr. Folsom recognizes this, although his remedy is a doubtful one, when he proposes that red and blue stripes be used to guide the patients in the corridors.

A dispensary for out-patients, if not under a separate management, should at least be a distinct department, with attendants, both medical and others, separate from those of the rest of the hospital.

The plan for the wards adopted by Dr. Folsom is a great improvement on the two and three story buildings so generally erected, but we have several objections to it :

1. The square-shaped ward would do very well for certain medical cases, but not for fevers and acute surgical cases. Compared with that usually adopted, in which the length is equal to the width multiplied by three, the wall-space is diminished, obliging the beds to be placed closer together, and if the service-rooms are attached as Dr. Folsom has them, one-third of the wall-space is cut off from the open air. Although the patients are nearer at hand and more equidistant from the heating apparatus than in the long ward, they are at the same time closer to a very common cause of infection, namely, the water-closets, sinks, etc.

2. There is no real separation of the ward from the service-rooms. The water-closets are very objectionably placed, and too few in number.

3. The wards are not on high basements, the floors being on the same level as that of the corridors. This is convenient for the administration, but we have never yet seen a corridor in which the circulation of air was not greatest in the direction of its length ; in fact, we are satisfied that it is the natural direction of currents in any closed, or even partially closed, narrow and long spaces, and that it is impossible to prevent these currents from end to end in corridors, and at the same time keep them warm in cold weather. If the wards, therefore, have direct communication with the corridor, the foul air of one ward will be carried to the others. It is a well-known fact that foul odors and kitchen-fumes are readily per-

ceptible in corridors at a distance of several hundred feet from the point of entrance, although the windows on opposite sides of the corridor are opened at several places between the two points. Except in climates where the severity of the winters absolutely necessitates closed corridors, the communication between wards should be merely covered ways.

4. The corridors in Dr. Folsom's plan are objectionable, not only because they are liable to carry foul air from one ward to another, but also because, on account of their height compared with that of the wards, they will in a great measure obstruct the free circulation of outside air. Suppose a wind to be blowing from the southwest, but little of its influence would be felt in pavilions 1, 2, 3, and 4, in his plan on the north side of the grounds.

5. The little dining-room across the corridor, with flat tin roof, only seven feet high, would be very hot in summer.

6. As Dr. Folsom places his wards on low basements, and takes the fresh air near the ground, it seems that he has not considered the dangers of ground-air, or that he does not give much weight to the late views of sanitarians on the subject. If hot water, heated by a small furnace attached to *each* pavilion, were used instead of steam, and the fresh air received from high leads, we think that the method of heating and ventilation proposed by Dr. Folsom would be very much improved.

7. His "isolating wards" would not be so objectionable if the service-rooms were removed from the centre and placed near one end, and separated from the ward for patients. But we would prefer to have a small ward of one or two beds in connection with the service-rooms of each pavilion, for the purpose of treating cases not infectious nor liable to cause infection, but which for some exceptional reason would be better removed from the ward. For these wards of Dr. Folsom's another name than that of "isolating wards" would be better, for they are certainly not suitable for the treatment of such cases as require isolation on account of being infected or liable to cause infection.

Dr. Folsom's pavilion for private patients is very complete, but it would be better if the service-rooms were detached, and we believe that it is very desirable to have separate buildings for the sexes, instead of one for both men and women.

The plan for the autopsy-building is very elaborate, and one of the best we have seen.

DR. JOSEPH JONES'S PLAN.

We find little in Dr. Jones's essay that is original or valuable, but he urges one excellent practice, namely, that of having the wards at certain intervals thoroughly cleansed and left open to the air and light for purification. He recommends that one-twelfth of the beds in each ward and one in twelve of all the wards be always left empty.

DR. CASPAR MORRIS'S PLAN.

The fourth essay, by Dr. Caspar Morris, is an able paper, containing many good suggestions, especially in regard to the details of construction and management, and is filled with facts left untold by others. It is, however, extremely conservative in the arguments against temporary buildings, and in favor of solid, two-story pavilions.

On page 200, when urging the great necessity of the utmost care in selecting building-material, and in carefully superintending the work, to make sure that it is well done, Dr. Morris says: "One open seam, or splintered edge of a joint, may become an irremediable source of contamination, in a ward otherwise without objection, and thus render useless all the expenditure of thought in contriving and money and labor and material in construction, and make unavailing the vigilance and neatness of service." And again, under the head of "Drainage," page 224, he says: "The whole system of drainage should be fully planned and laid out before any further progress is made in the arrangement of the buildings. The smallest negligence or oversight may render useless the utmost care and cost elsewhere."

Unless Dr. Morris expects to succeed in having hospital-construction reach perfection and remain so for generations, we cannot understand, after the above statements, why he should recommend so costly a plan as he does, and contend that every part should be solid and permanent in character. We do not say that all the wards of a hospital should be of a temporary character, but we repeat that compound fractures, amputations, fevers, and other cases liable to infect a building, should be treated in wards so constructed that, at any time deemed advisable, they may be removed and renewed at a small cost, and that all infected cases should be treated in temporary *isolated* huts or tents.

In most hospitals the number of patients requiring treatment in temporary buildings would not be large, probably not more than one in ten, while in other hospitals, on account of the proportionally large number of acute surgical and fever cases, it may be necessary to have one-fourth of the wards made temporary. From what Dr. Morris says concerning the Episcopal Hospital of Philadelphia, we infer that not many such cases are received in that hospital.

The great advantage as to the convenience of administration and comparatively smaller cost of the two-story pavilions over the one-story plan, so ably advocated by Dr. Morris, is by no means conceded by all authorities; on the contrary, many, especially those who have had the superintendence of hospitals constructed on the one-story plan, state that, as all the wards are on one level the administration is very much simplified and more convenient than in those hospitals where there are stairs, lifts, etc., and that the difference of cost has been very much over-estimated; that increased thickness of wall and strength of material, together with the necessary staircases, lifts, etc., required in the two-story plan, make up for the extra roof and foundation of the one-story pavilions.

To give our objections to Dr. Morris's plan would be to reiterate what we have already stated in our remarks on the preceding papers. We agree with him, that the greatest care should be given to the selection of the building-material, that the workmanship should be the very best, and that bad management, want of cleanliness, etc., etc., will render useless and unavailing the best-constructed hospital; but we do not think that all the advantages afforded by the one-story buildings can be attained in pavilions of two stories. We will formulate our opinion on this point by saying that, where the ground-space is sufficient to permit it, every ward of a hospital should be in a separate, one-story building, and that acute surgical, fever, and other cases liable to infect each other, or the building, should never be treated in two-story buildings.

DR. STEPHEN SMITH'S PLAN.

The last and, in many respects, the best of the five essays is by Dr. Stephen Smith. From a sanitary standpoint it is particularly interesting. Under the head of the "Site of the Hospital"

he gives us some interesting information on ground-air and ground-water. Accepting the views of Pettenkofer as to the evil influences of ground-air and ground-water, Dr. Smith suggests an elaborate plan for draining the ground of its air and water by "means of a heated shaft which communicates by its base with drain-pipes and conduits leading to all parts of the grounds at various depths." Such a system of drainage would undoubtedly improve the sanitary condition of the grounds, and make the soil a better absorbent and a "better disinfecter" of foul gases. To drain the ground of its air would be an experiment, and would cost something, but to drain it of its water would be a simple matter; and, although the ground may have many natural advantages, we believe that it would improve the sanitary condition of the hospital.

Dr. Smith's suggestions on grading and cultivation are valuable, but care should be taken in planting trees not to interfere with the free circulation of air.

One of the best parts of Dr. Smith's paper is on "The Classes of the Sick to be received." We prefer this classification of the patients to those given by the other essayists.

We accept his views on the questions of temporary *versus* permanent, and one *versus* two story pavilions, as well as his conclusion, page 296—"In the present instance, from every standpoint of view, we can but regard the question as settled in favor of permanent pavilions of one-story wards"—with this proviso, that some of these pavilions should be in part temporary, which he himself provides for in the classification of his pavilions (page 307 of his essay).

In many respects Dr. Smith's plan for his pavilions and connecting corridor is similar to that of the paper already referred to as having been read before the State Charities Aid Association; but (in his plans) he has failed to carry out with completeness some of the most important points of that plan:

1. He has only partially separated the service-rooms from the ward proper, and in his argument for this separation leaves out the best reasons for its adoption.

2. He recommends that the wards be placed on raised basements, and proposes that these basements should be *closed* and serve as hot-air chambers, instead of having the ward on arches with the surface beneath asphalted and open to the air and sun-

light, by which means the ward would be in no danger of receiving the much-dreaded ground-air.

3. We do not approve of having the water-closets in the basements, nor do we think that the corridor should be even partially underground, but altogether above the level of the ground, with the top not higher than the floors of the wards ; and it should connect with the service-rooms on the outside, and not pass between them and the ward.

4. If a second story to the service-rooms is needed to furnish sleeping-rooms for the helpers, a second story might be added, but we would not have any room up-stairs for the use of the patients.

5. We cannot consider favorably the method of heating and ventilation where Dr. Smith proposes that the wards should be heated by means of hot-air chambers beneath the ward-floor directly in contact with the ground. If such a system is adopted, it will indeed be necessary to drain the ground of its air ; and we are inclined to believe that, in spite of his carefully-constructed basements, he would fail to prevent these hot-air chambers from sucking up a large share of the ground-air, thus transmitting it to the wards, and so bringing about the very danger he tells us should be so carefully avoided. We would much prefer the well-known and well-tried plan of heating and ventilating by means of open fires. We would supplement these open fires by hot-water pipes in small boxes under the floor, and we would have hot-water pipes so arranged in the ventilating-shaft that when needed the hot water could be turned on and made to heat the shafts without warming the ward. By means of these hot-water pipes in the shafts the ward could be ventilated by suction, during the disagreeable, murky days of the year, when a fire in the ward would be uncomfortable, and the necessity of forced ventilation is so much felt ; thus we would avoid the expense of fan-ventilation.

Dr. Smith's observations on the defective medical education of this country are admirable, and ought to have great weight as coming from a college professor.

The idea of having a chapel used for school purposes might well be carried out, but in connection with the hospital for convalescents.

MR. JOHN R. NIERNSEE'S PLAN.

In the appendix to the five essays there is "A Description of the Plan adopted for the Johns Hopkins Colored Asylum," and also a plan by John R. Niernsee, the architect to the Board of Trustees, for an octagon-shaped ward. The latter, as he says, is very much the same as the square ward adopted by Dr. Folsom.

The octagon ward we like better than the square ward, because only one-eighth instead of one-third of the wall-space is cut off from the outside air by the contact of the service-rooms.

The closets in Mr. Niernsee's pavilion are well placed, and the direct communication with the air of the corridor is not so short as in Dr. Folsom's plan.

We heartily agree with Mr. Niernsee in some of his conclusions, especially three of them, viz :

1. "That hot-water heating is the most desirable and effective mode as auxiliary in connection with open fires."

2. Where he proposes "to dispense with a large and expensive apparatus concentrated in one place," and to have a small boiler for each pavilion.

3. Where he recommends that the top of the corridor should be on a level with the floor of the ward, and serve as a means of open communication ; but we would also raise the ward high enough to enable the corridor to be wholly above-ground. Air, like water, must be in motion to keep fresh and pure ; but it must also be acted upon by light, or its vital qualities will be greatly deteriorated.

In answer to Mr. Niernsee's argument that the octagon shape gives more cubic air-space in proportion to the wall-space than the oblong rectangular wards, we would say that the increase of air-space in a ward is not of great importance compared with the frequent, constant, and complete change of the air, and, instead of wall-space being a disadvantage, up to a certain point it is very desirable.

W. GILL WYLIE.

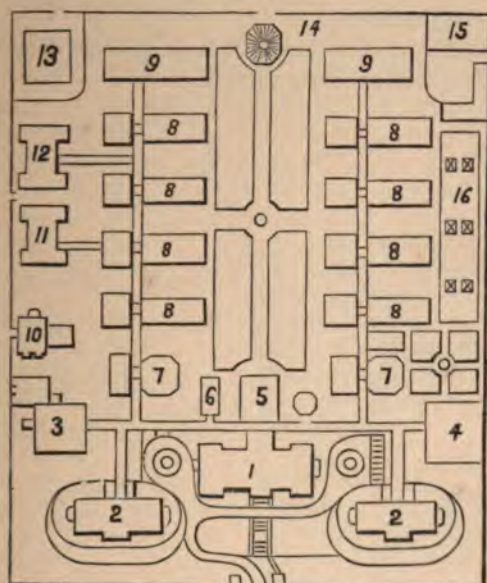
NEW YORK, *December*, 1875.

At the same time that I sent a copy of the above review to the trustees of the hospital, I forwarded a drawing, giving a plan for arranging the buildings on the ground almost exactly the same as

that in the plate, giving my suggested plan for a complete general hospital.

The following diagram is taken from the *New York Medical Record* of March 10, 1877. In a lecture, given to the medical pro-

FIG. 14.



"BLOCK PLAN FOR PROPOSED JOHNS HOPKINS HOSPITAL."

"EXPLANATION: 1. Administration Building; 2. Pay-Wards; 3. Kitchen; 4. Nurses' Home; 5. Dining-Rooms for Medical Officers and Nurses; 6. Pharmacy; 7. Two-Story Wards; 8. One-Story Wards; 9. Isolating Wards; 10. Residence of Superintendent; 11. Dispensary; 12. Operating-Theatre; 13. Mortuary Building; 14. Greenhouse; 15. Laundry; 16. Space for Tents."

fession of Baltimore, February 5, 1877, by J. S. Billings, M.D., "On the Plans for the Johns Hopkins Hospital at Baltimore," this plan was shown as that proposed for the hospital. Since the lecture we understand that the four rectangular wards, adjacent to the octagonal wards, in the figure, are to be changed into two pavilions of two stories, thus leaving only four instead of eight one-story pavilions. We do not know the details of construction decided upon; but there are three or four objectionable points about the

above plan : 1. The two-story pavilions ; 2. The position of the corridors and incomplete separation of the service-buildings ; 3. The so-called isolating wards, similar to those recommended by Dr. Folsom, and proximity of the tents to the ends of the wards ; 4. The scattered positions of the administrative building, which will interfere with easy administration, and necessitates a huddling together of the pavilions.

The plans are for three hundred beds, and not four hundred, as was originally intended there should be.

W. G. W.

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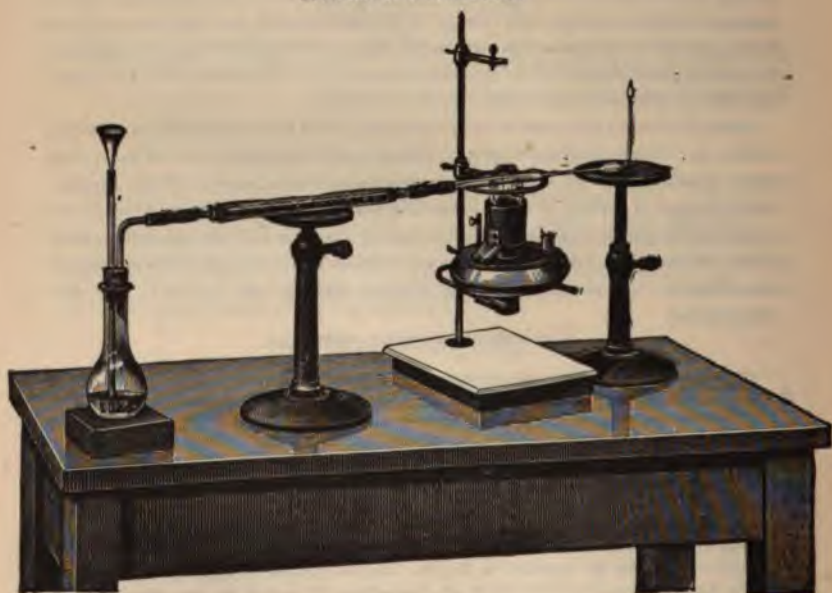
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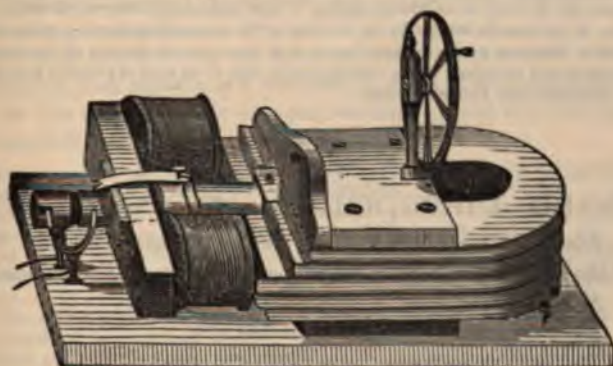
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